IN THE UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF TEXAS
HOUSTON DIVISION

ILA LAFRENTZ, et al.	§	
	§	
Plaintiffs,	§	
	§	
v.	§	**CIVIL ACTION NO.: 4:18-cv-04229**
	§	
3M COMPANY, et al.	§	
	§	
Defendants.	§	
	§	

DEFENDANT 3M COMPANY'S EXPERT WITNESS DISCLOSURES
UNDER FEDERAL RULE OF CIVIL PROCEDURE 26(a)

Defendant 3M Company ("3M") submits the following expert witness disclosures for expert witnesses it may use at trial.

PRELIMINARY STATEMENT

These disclosures are based upon information currently available to 3M. This is a lawsuit in which Plaintiffs allege that Plaintiff James B. LaFrentz was injured as a result of exposure to asbestos. Based on information known to date, the 3M 8710 respirator appears to be the only 3M product allegedly at issue in this matter. Discovery is still continuing in this action. This disclosure by 3M is based on the discovery that has been completed to date. 3M specifically reserves the right to amend, supplement or modify these disclosures at the conclusion of discovery in this case and as more information becomes known. Subject to the reservations stated herein, and 3M's right to supplement this disclosure, 3M discloses below its experts who may be called to testify at the time of trial.

3M COMPANY'S TESTIFYING EXPERT WITNESSES

Erik Johnson, M.P.H, C.I.H., C.S.P
3M Center Building, 235-2E-91
St. Paul, Minnesota 55144
(651) 737-2713

Mr. Johnson, who is a Certified Industrial Hygienist, will testify concerning various subject areas, including the design and utility of respiratory protection equipment manufactured by 3M which allegedly was worn by Plaintiff in this case. Mr. Johnson will also provide opinion testimony concerning the applicable regulations and industry standards relating to respiratory protection equipment. Further, Mr. Johnson may give opinion testimony addressing OSHA regulations and industry standards that apply to employers in this litigation.

Mr. Johnson has been employed by 3M for over 25 years. As a result of his experience and employment with 3M, Mr. Johnson has knowledge concerning the design and utility of 3M respiratory protection equipment. He will testify that 3M respiratory protection equipment is safe and effective for the intended purpose of the product. Mr. Johnson is familiar with the types of laboratory testing conducted by 3M for respiratory protection equipment, and will testify concerning the laboratory testing, findings of such testing, significance of the testing results, and that the testing conducted by 3M was appropriate and adequate. His testimony may include information concerning the materials and component parts utilized in the manufacture of 3M respiratory protection equipment. He may provide opinion testimony relating to the filtration capability of 3M respiratory protection equipment. Mr. Johnson may also testify as to the testing performed under conditions of humidity and temperature.

Mr. Johnson's testimony will include the subject areas of the testing of respirators by NIOSH and the United States Bureau of Mines (USBM). His testimony may also include

various provisions of 30 CFR 11 and/or 42 CFR 84, including the approval process, extensions of approval, approval labels and markings, quality control plans and other relevant regulatory provisions. He may explain 30 CFR 11 and/or 42 CFR 84 and other governmental regulations that apply to the testing and certification of respirators, including the laboratory testing conducted by NIOSH concerning filtration and pressure drop. His testimony may include an explanation of how the tests provided under 30 CFR 11 and/or 42 CFR 84 are conducted, the test challenge utilized, and the fact that the NIOSH testing and other testing establish that the 3M's NIOSH approved respiratory protection equipment provides appropriate respiratory protection against various dusts, including asbestos, under those circumstances in which the 3M respiratory protection equipment was appropriately selected and used. Mr. Johnson may testify that the laboratory testing conducted by NIOSH under the criteria of 30 CFR 11 and/or 42 CFR 84, although valid for certification, would not represent the conditions or concentrations that would be expected in a job site involving dust exposures where the maintenance free respirators would be appropriately selected and used. His testimony may also address the test conditions for certification under 30 CFR 11 and/or 42 CFR 84, including the loading of the respirator being tested and the resulting airflow resistance for final inhalation and exhalation do not represent actual workplace conditions where the 3M respiratory protection equipment would be appropriately selected and worn.

Mr. Johnson may testify that the NIOSH laboratory testing, including the certification testing was performed in order to assess the potential breathing resistance of the tested respirator, and that the ease with which a worker breathes through any respirator potentially impacts upon the comfort of the person wearing the respirator. Mr. Johnson may testify that an employee, who has been properly trained by the employer, will discard a maintenance free respirator if the

respirator is damaged or if breathing resistance is excessive. Mr. Johnson may testify that an increase in the breathing resistance of a respirator does not affect the health of a worker. Mr. Johnson may explain the results of testing of 3M respiratory protection equipment and the significance of such testing of any alleged exposure experienced by Plaintiff in this case. In that regard, Mr. Johnson will testify regarding laboratory or workplace testing of 3M respiratory protection equipment relating to asbestos or other contaminants conducted by 3M, Los Alamos Scientific Laboratory, McGill University, the Institute of Occupational Medicine and others. Mr. Johnson may offer testimony that the initial certification of certain 3M respiratory protection equipment was for respiratory protection against pneumoconiosis and fibrosis-producing dusts, including, but not limited to, asbestos.

Mr. Johnson’s testimony may include an explanation of Permissible Exposure Levels (PELs) and Threshold Limit Values (TLVs). He may offer testimony regarding the acceptance of PELs and TLVs by industrial hygienists, certified safety professionals and others. He will also explain the relationship between PELs or TLVs and assigned protection factors for respirators,. His testimony may also relate to the subject areas of particle technology, aerosol physics, particle measurement, particle size distribution, inhalation, exhalation, breathing resistance, filtration, pressure drop and the potential deposition of particle into the lung.

Mr. Johnson has personally performed work in the laboratory and in the field concerning the fit of various types of 3M respiratory protection equipment. He will testify regarding workplace protection factor testing performed by 3M, DuPont, Duracell and others. He may testify on the subjects of protection factors, wear factors, and other related topics. Mr. Johnson may offer opinion testimony that the appropriate protection factors that should be assigned to particular 3M respiratory protection equipment. Mr. Johnson may testify relative to his

experience and knowledge relating to the evolution of the design, use and acceptance of respirators by workers, the methods used to determine the fit of half-facepiece dust respirators and other related subject areas. His testimony may include at all times, the design of the 3M respiratory protection equipment allowed the employer and/or employee to properly fit the respirator and to test the facepiece-to-face seal of the 3M respiratory protection equipment. Mr. Johnson may offer testimony relating to the capability of the 3M respiratory protection equipment to fit employees, and will include within the subject of the fit, fit testing performed by 3M and others, which establishes that the 3M respiratory protection equipment provide an appropriate fit. He may testify that the workplace protection factor studies conducted by 3M and others establish that, in the workplace, the protection provided by a properly fitted 3M respirator will equal or exceed the assigned protection factor for such products. In addition, Mr. Johnson may testify regarding the published studies by OSHA designating the assigned protection factors for half-facepiece particulate respirators. Mr. Johnson may also express the opinion that qualitative fit testing using a validated fit test protocol with test challenges such as saccharin and other validated test challenges represents an appropriate method for an employer to assess the fit of a respirator selected for use by an employee. In addition, he may offer testimony addressing 3M's research, development and testing relating to respirators that 3M introduced to provide employers an opportunity to perform quantitative fit testing. Mr. Johnson will provide testimony concerning 3M's research, development and testing of saccharin as an acceptable fit test challenge and the availability of the 3M Qualitative Face Fit Kit.

Mr. Johnson has reviewed various packages and advertisements relating to 3M respiratory protection equipment. He will testify that the packaging and advertising relating to 3M respiratory protection equipment was reasonable and appropriate at the time of publication.

He will explain that in addition to the packaging, 3M made available to employers information, literature and training concerning the respiratory protection equipment manufactured by 3M. His testimony will include specific reference to additional materials and communications that would have been available upon request by employers in this litigation. He will address the lack of training provided by Plaintiff's employers concerning the use of respiratory protection equipment and the hazards of asbestos.

As a Certified Industrial Hygienist, Mr. Johnson has knowledge concerning the OSHA regulations and industry standards that apply to the responsibilities and obligations of the employers in this litigation. He is also knowledgeable concerning OSHA Directives relating to 29 CFR 1910.1001 and 29 CFR 1910.134 and the subject of respiratory protection. His testimony may include an explanation of the controlling OSHA regulations and industry standards, such as ANSI Z88.2, 1969, 1980 and 1992, and the 29 CFR 1910.134 and the requirement for written respiratory protection programs. Mr. Johnson will provide opinion testimony that based upon accepted industrial hygiene principles, workplace safety practices, and applicable OSHA regulations, the employer has the responsibility to inform and advise employees exposed to hazardous dusts of the potential health consequences of exposure and to communicate other relevant information to employees. Mr. Johnson may testify concerning the violation by employers in this litigation of the controlling OSHA regulations, industry standards, industrial hygiene practices and accepted workplace practices, and the employee's responsibilities. Mr. Johnson will testify relating to applicable OSHA regulations concerning asbestos. He may also testify concerning Plaintiff's asbestos exposure as well as Plaintiff's use of respiratory protective equipment.

3M reserves the right to offer Mr. Johnson's expert opinion testimony concerning any

issue raised by other experts or any other party in this litigation, provided these opinions are within his fields of expertise. 3M reserves the right to offer Mr. Johnson's expert opinion testimony regarding any other 3M protective equipment which may be put at issue by plaintiff.

Mr. Johnson's expert report, list of prior testimony and CV are attached as Exhibit A and are incorporated herein.

Dennis J. Seal, Ph.D., P.E.
Seal Design and Engineering, Inc.
Human Factors and Product Safety
5423 Vanderbilt Avenue
Dallas, Texas 75206
(214) 823-9364

Dr. Seal may testify in the subject areas of warnings, human factors product safety engineering and employer responsibility. He may provide opinion testimony concerning the subject areas of packaging, advertisements, sales literature, training literature and other information relating to 3M respiratory protection equipment.

Dr. Seal has reviewed various documents and materials concerning 3M respiratory protection equipment and is familiar with the literature and other information which was made available by 3M to distributors and potential customers. He may explain that in addition to the packaging for the 3M respiratory protection equipment, 3M made available to employers information, user guides, literature and training concerning respiratory protection equipment manufactured by 3M. His testimony may include specific reference to additional materials and communications which would have been available upon request by employers in this litigation. Dr. Seal will testify concerning applicable OSHA regulations, including the 29 CFR 1910.134, the OSHA Hazard Communication ALT, and industry standards which apply to the conduct of employers in this litigation. In that regard, he may offer opinion testimony addressing the

function and purpose of information provided by the manufacturers of products which are to be used in a regulated work environment.

Dr. Seal may testify that the information that accompanied 3M respiratory protection equipment by way of labeling or packaging represented reasonable and appropriate information for the use and limitations of such products. He may further offer opinion testimony that the packaging, advertisements, sales literature, training literature and materials provided by 3M relating to 3M respiratory protection equipment were reasonable and provided appropriate information. He may testify that, as to Plaintiff, the most effective means or method of providing warnings or instructions to Plaintiff would be the communication of that information from Plaintiff's employers. He may explain that the applicable OSHA regulations provide that, for purposes of training, instruction, supervision and warnings, the employer, and not the manufacturer of products, such as 3M, is in the best position to effectively communicate with employees. Dr. Seal may offer opinion testimony that based upon accepted industrial hygiene principles, workplace safety practices and applicable OSHA regulations, the employer has the responsibility to inform and advise employees exposed to asbestos or other hazardous dusts of the potential health consequences of exposure and to communicate other relevant information to employees.

Dr. Seal may testify that, in his opinion, 3M respiratory protection equipment presents no significant health hazard. Dr. Seal may also testify that a warning, as defined by ANSI Z535.4, is not necessary for 3M respiratory protection equipment. Finally, Dr. Seal may express the opinion that the placement or inclusion of additional information on the packaging of 3M respiratory protection equipment would not modify or alter the conduct of Plaintiff in this case.

With respect to other 3M respiratory protection equipment that Plaintiff allegedly used, if any, Dr. Seal may testify as to any of the areas of testimony set forth above, including as to other 3M respiratory protection equipment, the subject of warnings, ANSI Z535.4, and the employer's responsibility.

3M reserves the right to offer Dr. Seal's expert opinion testimony concerning any issue raised by other experts or any other party in this litigation, provided these opinions are within his fields of expertise.

Dr. Seal's expert report, list of prior testimony and CV are attached as Exhibit B and are incorporated herein.

Philip D. Eitzman, Ph.D.
3M OH&ESD
3M Center
Building 235-2B-86
St. Paul, Minnesota 55144
(651) 733-3483

Dr. Eitzman is an employee of 3M. He received a B.S. Ch.E. in Chemical Engineering from the University of Florida in 1986 and his Ph.D. in Chemical Engineering from the University of Minnesota in 1994. Dr. Eitzman began his employment at 3M in 1991 in the Bioapplications Laboratory. He joined the Occupational Health and Environmental Safety Division, which manufactures and sells 3M's respiratory protection equipment, in 1994, where he was a Maintenance-Free Respirator Laboratory Group Leader. Dr. Eitzman's work has included the development of filter media for respiratory protection equipment, as well as the development of disposable respirators, respirator design, manufacturing equipment design and quality control. In addition, Dr. Eitzman is the holder of numerous patents pertaining to respirator filter media. Because Dr. Eitzman is an employee of 3M Company, there is no charge for his testimony.

Dr. Eitzman's opinions are based on his education, training, experience and his review of various 3M documents and data, the testimony and opinions of various 3M lay and expert witnesses, scientific publications, texts and studies, the pleadings and other documents and evidence in this case. Dr. Eitzman has consulted various other sources concerning the matters at issue in this action. Dr. Eitzman may be asked to review and respond to any testimony and documents produced by the parties in this action, and testimony of other witnesses, including lay or expert witnesses, whose testimony or information is not reasonably available by the time of his deposition.

Dr. Eitzman has reviewed, evaluated and analyzed the testing conducted by 3M for 3M respiratory protection equipment and if called, he may testify concerning that testing, including testing performed for purposes of quality control and quality assurance, the results of such testing, and his opinions that the testing conducted by 3M, and the decisions based thereon were appropriate. In addition, Dr. Eitzman will testify about the filtration capability of 3M respiratory protection equipment. Dr. Eitzman may testify regarding laboratory and workplace testing on 3M respiratory protection equipment relating to asbestos or other dusts conducted by 3M, Los Alamos Scientific Laboratory, McGill University, DuPont, and the Institute of Occupational Medicine and others.

Dr. Eitzman is familiar with the materials and process used by 3M in the manufacture of the filter media and other components of 3M respiratory protection equipment. His experience includes knowledge of the various studies and tests related to 3M respiratory protection, including the testing of respiratory protection equipment under the criteria of 30 CFR 11 and/or 42 CFR 84 and testing performed for purposes of quality control, quality assurance, or otherwise. Dr. Eitzman may testify concerning the testing and certification of respiratory protection

equipment, including the laboratory testing conducted by NIOSH concerning filtration and pressure drop. He may testify that in 1972, the government certified certain 3M respiratory protection equipment for respiratory protection against pneumoconiosis- and fibrosis- producing dusts, including asbestos. He may testify that at all relevant times 3M respiratory protection equipment maintained its certification with NIOSH. He may also testify that the laboratory testing conducted by NIOSH under the criteria of 30 CFR 11 and/or 42 CFR 84 with respect to pressure drop was performed in order to assess the potential breathing resistance of the tested respirator, and that the ease with which a worker breathes through any respirator potentially affects the respirator user's comfort and acceptance of the respirator by the user. He may further testify that the breathing resistance of respiratory protection equipment is not an issue of health for the worker. He may offer an opinion concerning the results of studies and tests performed on 3M respiratory protection equipment and any other product identified, under the testing criteria of 30 CFR 11 and/or 42 CFR 84, and with other testing performed by 3M in the laboratory or elsewhere, including the testing with sodium chloride and dioctyl phthalate. Dr. Eitzman is also familiar with tests performed relating 3M respiratory protection equipment under conditions of extreme and prolonged humidity and high temperature, such conditions being more extreme than a workplace setting.

Dr. Eitzman may provide testimony addressing the filtration efficiency of any 3M respiratory protection equipment relative to particle size distribution of respirable dust. He may also testify generally relating to the capture mechanisms of the respiratory system. Dr. Eitzman may testify that the established permissible exposure limits (PELs) and threshold limit values (TLVs) are recognized and accepted by the Occupational Health community as a means for assessing potentially hazardous exposures.

Dr. Eitzman may testify that based upon his education, experience, training or knowledge of testing relating to 3M respiratory protection equipment the respirator, as tested and certified by NIOSH, could be used to provide respiratory protection up to 10x PEL. He may testify that workplace protection factor studies conducted by 3M and others establish that, in the workplace, the protection provided by a properly fitted 3M respiratory protection equipment will equal or exceed the assigned protection factor of 10 for half-facepiece respirators. He may also testify about the filter media used by 3M for their respiratory protection equipment and that the filter media provided a safe and effective means of filtration. His testimony may also relate to the subject areas of particle technology, aerosol physics, particle measurement, particle size distribution, inhalation and exhalation, breathing resistance, filtration and the potential deposition of particles into the lung.

Dr. Eitzman may provide opinion testimony that the testing and certification of 3M respiratory protection equipment and any other product identified, pursuant to 30 CFR 11 and/or 42 CFR 84, represented a scientifically valid and acceptable test for determining the filtration efficiency of a respirator. He may testify that the testing conducted under the criteria of 30 CFR 11 and/or 42 CFR 84 was an equally valid test of the filter efficiency of a respirators as dusts performed using other test challenge agents, such as sodium chloride or dioctyl phthalate.

Dr. Eitzman may testify relating to the fit of 3M respiratory protection equipment. He may testify concerning how fit testing performed by 3M and others establishes that 3M respiratory protection equipment will provide a worker with the appropriate fit of the respirator. He may testify that the design of 3M respiratory protection equipment allowed the employer/employee to properly fit the respirator and test the facepiece-to-face seal of such respiratory protection equipment. If called, Dr. Eitzman may also provide opinion testimony that

typical workplace conditions of high humidity or temperature will not adversely affect the filter efficiency of 3M respiratory protection equipment.

3M reserves the right to offer Dr. Eitzman's expert opinion testimony concerning any issue raised by other experts or any other party in this litigation, provided these opinions are within his fields of expertise. 3M reserves the right to offer Dr. Eitzman's expert opinion testimony regarding any other 3M protective equipment which may be put at issue by plaintiff.

3M reserves the right to offer Dr. Eitzman's expert opinion testimony concerning any issue raised by other experts or any other party in this litigation, provided these opinions are within his fields of expertise.

Dr. Eitzman's expert report, list of prior testimony and CV are attached as Exhibit C and are incorporated herein.

Dr. Thomas M. Wheeler
Baylor College of Medicine
Department of Pathology & Immunology
One Baylor Plaza, Room T203
Houston, TX 77030
(713) 798-4664

Dr. Wheeler is a board certified pathologist. Dr. Wheeler may be called to testify concerning asbestos related diseases and the effects of exposure to various asbestos containing products upon persons in occupational settings. He may further testify regarding the epidemiology of asbestos diseases, the criteria for diagnosis of asbestos related disease, as well as the existence of a dose response relationship between exposure to asbestos and asbestos related diseases.

Dr. Wheeler may also testify regarding the existence or non-existence of any alleged asbestos related disease in the Plaintiff, including but not limited to pleural changes,

asbestosis, mesothelioma, and dust respirability, where applicable. He will also testify on general medicine issues regarding asbestos related diseases including, but not limited to, lung physiology, lung function, lung defense mechanisms and the mechanisms by which asbestos fibers do or do not cause a particular disease.

Dr. Wheeler may also testify regarding the biological effects of asbestos and the evidence of the relationship between the inhalation of various forms of asbestos fibers and asbestos-related disease and the factors that go onto evaluating whether there is any medical risk from asbestos-containing products. Dr. Wheeler may also be asked to respond to the testimony of certain witnesses offered at the time of trial including, but not limited to, testimony from plaintiff's experts regarding the alleged hazards of exposure to particular products and their alleged propensity to release fibers.

Dr. Wheeler's testimony will be based on one or more of the following: his training, experience, education, publications and review of the medical, governmental and scientific literature and various air sampling studies, work facility inspections and documents, where applicable, as well as review of medical records, chest films, and all pathology materials. Dr. Wheeler may rely upon the exhibits, testing and testimony otherwise disclosed by this defendant in this case. Dr. Wheeler may review Plaintiff’s and coworker's deposition testimony given in this case and rely upon them as a basis for his opinions. He may also provide testimony consistent with the disclosure of any other expert disclosed by this defendant or any other party to this case. As this defendant becomes aware of additional facts and the opinions of plaintiff's experts, Dr. Wheeler will testify as to the opinions suggested by the additional facts or in response to the opinions of plaintiff's experts.

Dr. Wheeler’s CV is attached as Exhibit D and is incorporated herein.

Jennifer Sahmel, M.P.H., C.I.H., C.S.P., F.A.I.H.A.
Insight Risk, LLC
1035 Pearl Street
Boulder, CO 80302

Ms. Sahmel is Certified Industrial Hygienist (CIH) [American Board of Industrial Hygiene (ABIH)] and a Certified Safety Professional (CSP) [Board of Certified Safety Professionals (BCSP)] with 20 years of experience in human health exposure, risk assessment, and workplace health and safety, she is also a Fellow of the American Industrial Hygiene Association (FAIHA). She has experience in exposure assessment methodologies, the history and state of the science for industrial hygiene over time, health risk decision making, exposure monitoring, and safety management systems, and has conducted chemical-specific exposure assessments for a wide range of substances.

Ms. Sahmel will testify at trial regarding occupational exposures of Plaintiff as described by Plaintiff, Plaintiff's co-workers, and other alleged exposure witnesses and whether such exposures could be considered as creating a scientifically significant amount of risk for the development of an asbestos-related disease, including the manner in which risk assessment properly may be performed for individuals in various trades or occupations, and a risk assessment for the plaintiffs in these cases.

Ms. Sahmel may testify regarding the recognition, evaluation and control of health and safety hazards, as well as the accepted standards, industrial hygiene practices and workplace safety practices during the years of Plaintiff's employment. She may further testify as to the principles of industrial hygiene and the factors that are important to industrial hygiene studies, the manner in which experts use industrial hygiene data and how the data should be interpreted in specific cases, and the manner in which industrial hygiene data should be properly considered in evaluating exposures.

Ms. Sahmel may further testify as to the state of the art of industrial hygiene during the times relevant to Plaintiff's alleged exposures. State of the art testimony may including whether it was recognized that a risk of development of asbestos-related disease was recognized for persons such as Plaintiff and the appropriate steps to guard against that recognized risk, if any.

She may further testify as to the development and utility of methodologies identifying and measuring asbestos in air, dust and products, and the process of setting threshold limit values ("TLVs"), the OSHA PELS, and other levels for asbestos exposure. This testimony will also include the historical standards and recommendations from both governmental and non-governmental agencies concerning workplace levels of asbestos exposure.

Ms. Sahmel may further testify as to the relationship between scientific knowledge and the development of public policy standards relating to asbestos exposure, and all aspects of government regulation of asbestos exposure. In addition, she may testify to the development of knowledge regarding the dose-response relationship between exposure to asbestos and disease, and other related matters.

She may testify regarding expert testimony or opinions offered on behalf of Plaintiff, including but not limited to testimony, if any, regarding the evolution of knowledge of the effects of asbestos exposure, standards and regulations applicable to asbestos exposure, and testing done by or on behalf of Plaintiff. She may also testify regarding the asbestos exposure described by Plaintiff, Plaintiff's co-workers, and other alleged exposure witnesses in this case.

Ms. Sahmel may further testify as to the different types of asbestos fiber, their physical and chemical composition, characteristics and uses in various products as well as their potential to cause disease. She may also testify to the exposures in this case, as described by Plaintiff,

Plaintiff's co-workers, and other alleged exposure witnesses in this case, and whether the alleged exposures created a significant risk of asbestos-related disease.

Ms. Sahmel is also expected to testify and opine that Plaintiff's employers were responsible to provide Mr. Mullins with a safe and healthful workplace, and to follow applicable workplace safety regulations; Mr. Mullins' employers were responsible to understand and know the concentration of hazardous dust in the workplace and bring the workers' exposure to dust, such as asbestos, below the PEL; Mr. Mullins' employers were responsible to know the concentration of the dust in the workplace and to select the proper safety equipment including respirators used in his workplace operation.

She may further testify as to the proper and accepted protocols for analysis of airborne samples for fiber release from asbestos-containing products, the potential for various products to release asbestos fibers, and the government and industry standards regarding the same.

In formulating her opinions, Ms. Sahmel may rely upon both unpublished and published studies regarding the manufacturing, handling, installation, and removal of asbestos-containing products and materials.

Ms. Sahmel's expert report, list of prior testimony and CV are attached as Exhibit E and are incorporated herein.

Expert Witnesses Designated by Co-Defendant General Dynamics Corporation

3M cross-designates and incorporates by reference the expert witness disclosures, expert reports, CVs and list of prior testimony of Co-Defendant General Dynamics Corporation for the following witnesses:

Tim D. Oury, M.D.
Department of Pathology
University of Pittsburgh
S-785 Scaife Hall

3550 Terrace Street
Pittsburgh, Pennsylvania 15261

C. Alan Brown, M.D.
Cottage Health
400 West Pueblo Street
Santa Barbara, California 93105

Respectfully Submitted,

/s/ *Michele E. Taylor*
William Book
Southern District Bar No. 1761
Michele E. Taylor
Southern District Bar No. 14240

TAYLOR BOOK ALLEN & MORRIS, L.L.P.
1221 McKinney, Suite 4300
LyondellBasell Tower
Houston, Texas 77010
Telephone: (713) 222-9542
Facsimile: (713) 655-7727
E-mail: wbook@taylorbook.com
mt@taylorbook.com

CERTIFICATE OF SERVICE

I hereby certify that on this 14th day of August, 2020, I electronically filed the foregoing Defendant 3M Company's Expert Witness Disclosures Under Federal Rule of Civil Procedure 26(a) with the Clerk of the Court using the CM/ECF system, and I hereby certify that I have thereby electronically served this document upon all counsel of record who are registered with the Court's CM/ECF system.

BY: /s/ Michele E. Taylor
Michele E. Taylor
Counsel for Defendant, 3M Company

Exhibit A

REPORT OF ERIK JOHNSON

Ila LaFrentz, Jim LaFrentz, Katherine Porterfield and William LaFrentz, Individually and as Representatives of the Estate of James B. LaFrentz vs. 3M Company, et al.

This report includes my opinions relating to the case Ila FaFrentz, Jim LaFrentz, Katherine Porterfield and William LaFrentz, Individually and as Representatives of the Estate of James B. LaFrentz vs. 3M Company, et al. My opinions are based on my education, years of experience in industrial hygiene, and my work with personal protective equipment including respirators. This includes various OSHA standards such as 29 CFR 1910.134 (respiratory protection), 29 CFR 1910.100 (asbestos), 29 CFR 1910.1025 (lead), proceedings and final rule on Assigned Protection Factors, etc.; NIOSH standards 30 CFR 11 and 42 CFR 84 (respirators); and ANSI Z88.2 (respirators). I have also reviewed the 3M 8500 and 8710 advertising, packaging, user instructions, laboratory testing, qualitative and quantitative fit testing, workplace testing, and other related documents. In addition, this report is based on my review of the following documents:

1. *Deposition transcript of James LaFrentz, taken 11/14/2018;*
2. *Deposition transcript of James LaFrentz, taken 11/15/2018;*
3. *Exhibits to the depositions of James LaFrentz;*
4. *Plaintiffs' Third Supplemental Rule 26(A) Disclosure;*
5. *Expert Report of Darell Bevis;*
6. *Expert Report of Ken Garza;*
7. *Plaintiffs' Second Amended Complaint*

I have a Bachelor's degree in physics from St. Olaf College in Northfield, MN (1991). I worked as an intern and tech aide in the 3M Occupational Health and Environmental Safety Division assembling and testing prototype respirators and filter material (1991-1994). My Master's degree is in Industrial Hygiene from the University of Minnesota (1994). I have worked as a tech service representative in OH&ESD (now 3M Personal Safety Division) from 1994 to the present. In that role I have been responsible for disposable, reusable, powered and supplied air respirators; respirator selection guides and software programs; diffusion and electronic gas/vapor monitors; technical writing and training; and Asia/Pacific region for most of the OH&ESD/PSD products. I am a certified industrial hygienist (1994) and certified safety professional (2017).

My testimony in this case may include a variety subjects including the design, development, testing and effectiveness of respirators manufactured by 3M and allegedly worn by Mr. LaFrentz. It is my opinion that 3M respirators including the 3M 8710 are safe and effective when properly selected, fitted, worn, maintained/disposed, etc. according to relevant standards, regulations and industrial hygiene principles.

Referring to the 8710 as a "paper mask" is incorrect. It consists of an inner shell, a non-woven polypropylene filter media and a coverweb. None of the three layers are paper.

The 8710 was developed in the late 1960s to early 1970s. 3M worked in conjunction with Dr. Irving Selikoff (Mount Sinai School of Medicine), the International Association of Heat and Frost Insulators and Asbestos Workers and others to develop disposable particulate respirators that were easier to breathe through and more consistently worn than elastomeric respirators.

The 8710 was approved May 24, 1972 by the US Bureau of Mines as a single use dust respirator under 30 CFR 11. It was approved for respiratory protection against pneumoconiosis and fibrosis producing dusts, including but not limited to aluminum, asbestos, coal, flour, iron ore or free silica (TC-21C-132). The approval was later extended by the US National Institute of Occupational Safety and Health (NIOSH) to also include dusts and mists not having an exposure limit less than 0.05 mg/m^3. 3M continually maintained the NIOSH approval on the 8710 through 1998, when the product was discontinued due to revised NIOSH regulations 42 CFR 84.

Extensive testing has been done over the years to demonstrate that the 8710 can filter various types of particles, including submicron aerosols. Laboratory testing has been done against silica dust, asbestos fibers, sodium chloride, DOP and lead dust. 3M testing showed that the 8710 had high filtration efficiency against silica dust in both the unloaded (new) and loaded state. Testing done at the University of Minnesota demonstrated the ability of the 8710 to filter particles of various sizes (including particles <0.1 μm) and at different flow rates. The U of MN authors also noted that the 8710 had both lower penetration and breathing resistance than a similar respirator from a different manufacturer.

The mass median diameter of particle distributions in industrial workplaces is predominantly larger than the aerosols used to test respirators. Thus, filtration efficiency in workplaces would be higher than seen in most laboratory testing. Put another way, most occupational exposure limits for dusts are expressed as mass per volume of air (mg/m^3). Larger particles have more mass and are easier to filter. Therefore, particulate respirators such as the 8710 filter workplace aerosols to help reduce exposure commensurate with relevant occupational exposure limits. Occupational asbestos exposure is measured as fibers per cubic centimeter of air (f/cc), but only fibers longer than 5 μm are counted. These sized fibers are efficiently filtered by particulate respirators such as the 8710.

I expect to testify that although fit test terminology and methods have changed over time, there has always been a fit test method for 8710 users that met relevant standards and regulations. In the 1960s and 70s, none of the respirator fit test methods were validated similar to today's practices. In the ANSI Z88.2-1969 standard for respiratory protection, users were advised to check the fit each time the respirator is put on by following the manufacturer's instructions and then lists examples such as the positive pressure and negative pressure test.

The 8710 packaging contained information, instructions, and warnings that were appropriate for their time. Similar to the positive pressure test listed above, the 8710 packaging contained instructions on how to put the respirator on, mold the noseclip, adjust the straps, check the fit by exhaling vigorously and readjusting if leaks were detected. In 1976 and 1978, the US National Institute for Occupational Safety and Health (NIOSH) listed negative and positive pressure tests as qualitative fit test methods.

In the ANSI Z88.2-1980 standard for respiratory protection, optional qualitative fit tests included using a stream of coal dust, talcum powder or fluorescein liquid particles. One validation of the donning and fit may be seen in 8710 prototypes worn in a coal dust test chamber with no visible leakage. In the 1980s 3M developed a "large particle" quantitative fit test to allow quantitative fit testing of dust/mist and

dust/fume/mist respirators. This advancement in technology led to research indicating that the positive pressure fit check used with disposable respirators such as the 8710 was effective in detecting poor fits.

In section (e)(5) of the original OSHA standard for respiratory protection 29 CFR 1910.134, it is stated that "Training shall provide the men an opportunity to handle the respirator, have it fitted properly, test its face-piece-to-face seal, wear it in normal air for a long familiarity period, and, finally to wear it in a test atmosphere." But at that time the purpose of the "test atmosphere" was not defined. Nor were specific fit test methods listed. In 1980 OSHA issued a "Federal Program Change" memo indicating that wearing respirators in a test atmosphere was for assessing respirator fit using recognized qualitative or quantitative fit methods. About the same time, the ANSI Z88.2-1980 standard and subsequent revisions began to define qualitative fit tests as using a test agent that is filtered by the respirator being tested.

3M developed the saccharin aerosol fit test method circa 1980. It was designed for fit testing various types of particulate respirators including the dust/mist, dust/mist/fume and HEPA classes. The saccharin method was validated by Los Alamos National Laboratory, Lawrence Livermore Laboratory, DuPont and 3M. It was later included by OSHA in standards such for lead and the updated standard for respiratory protection. Later, 3M developed the Bitrex™ aerosol qualitative fit method which was also included in the revised OSHA standard for respiratory protection.

Laboratory based "respiratory protection factors" have done on various types of respirators worn by people exposed to aerosols of various types and sizes. However, these tests may not be applicable to workplace performance as will be described.

Ed Hyatt (Los Alamos National Labs) used submicron aerosols, subjects of different facial sizes, and exercises of 1) normal breathing, 2) deep breathing, 3) turning head slowly form side to side, 4) moving head up and down and 5) talking. Respirators tested were described in his report as approved under the earlier Bureau of Mines Schedule 21B, which would not include the 3M 8710 (approved under 21C). However, in separate report, Hyatt identifies the 8710 as respirator "I" in table D. Based on his data, Hyatt assigned single use dust respirators a protection factor of 5 (assuming they are used in a respirator program that meets the OSHA standard 1910.134). However, Hyatt states that if also tested against asbestos or cotton dust, these respirators could be assigned a 10 for those particulates. Because the 8710 was tested against asbestos, it is appropriate to give it a protection factor of 10 when used against asbestos according to Hyatt.

It should be noted that Hyatt used particles with a mass median aerodynamic diameter (MMAD) of about 0.6 μm. This is about 1/6 of the size of the silica dust test used for respirator certification: 0.4-0.6 μm, count based. (For the same aerosol size distribution, mass based diameters are larger than count based diameters.) Therefore, much of the penetration observed would have been from filter penetration instead of face seal leakage. Most workplace aerosols are much larger, and therefore the protection factors in workplaces would be higher. 3M repeated Hyatt's work using modified versions of the 8710 with higher filter efficiency to minimize filter penetration (similar to what would be seen in workplaces) and saw protection factors of 18-52.

In contrast to laboratory testing, workplace protection factor (WPF) testing measures performance in the workplace for of a respirator that has been properly selected, fitted, used and maintained. These has been much discussion on the proper protocol including worksite selection, sampling procedure, data

analysis, etc. WPF testing on 8710 has included silica in a foundry, asbestos removal, asbestos exposure in manufacture of truck brakes, an alkaline battery plant, a steel mill and a lead battery plant.

Additionally, Thomas Nelson reviewed data from several workplace protection factor studies for various half mask respirators and concluded that disposable dust/mist respirators (including the 8710) had protection factors with a geometric mean of 224 and a lower 5th percentile of 22.4. He also concluded that there was no significant difference in performance between reusable and disposable half mask respirators.

I expect to testify regarding applicable regulations related to asbestos. In 1971 (prior to the introduction of the 8710), OSHA allowed negative pressure reusable or single use respirators for asbestos exposures up to 5 times the exposure limit. In 1972, OSHA stated that these same respirators, which included the 8710, could be used for asbestos exposure up to 10 times the exposure limit. In 1986 OSHA revised the asbestos standard and required as a minimum half facepiece respirators with high efficiency filters. However, in the preamble to the standard, "OSHA notes that the testing of respirator effectiveness for asbestos (the LASL and DuPont studies) suggest that certain respirators within a class appear to perform better than other respirators within the same class. For example, the 3M 8710 appears to provide better protection than the other respirators in its class as a single-use respirator."

The ANSI Z88.2-1969 standard for respiratory protection did not contain numerical protection factors, but rather general guidance for respirator selection. The 1980 and 1992 versions of the ANSI Z88.2 standard have half mask air purifying respirators, including the 8710, listed with a protection factor of 10.

OSHA published its "Assigned Protection Factors; Final Rule" in 2006. Most of the data is based on respirators approved under 30 CFR 11, including the 8710. After reviewing the data, OSHA concluded that half mask air purifying respirators, including the 8710, have an assigned protection factor of 10. This means that when used in an OSHA compliant respirator program, half mask air purifying respirators such as the 8710 would reduce inhalation exposure by at least a factor of 10 (or 90%).

I will testify that it is the employer's responsibility to ensure that respirators used in workplace are part of a compliant respirator program. The ANSI Z88.2 and OSHA standards such as 29 CFR 1910.134 list components of an acceptable respirator program including:

- Program administrator
- Written procedures
- Exposure monitoring
- Using engineering controls to minimize exposure
- Proper respirator selection based on the hazards
- Employee training in proper respirator use and limitations
- Fit testing of respirators
- Respirator cleaning, inspection, maintenance and storage
- Medical evaluation
- Regular determination of program effectiveness

It is critical that respirators are worn during the entire time of exposure. Lack of visible dust does not indicate absence of a respirable hazard. If a respirator is removed for any reason during exposure, then the user will be fully exposed during that time.

The 8710 helps reduce respiratory exposure when used according to OSHA standards and industrial hygiene principles. It is my opinion that the 3M 8710 respirators used by James LaFrentz were not defective in any manner. If asked about the 3M 8500, I will testify that it was for non-toxic dusts.

Based on the documents provided to me in this case, Mr. LaFrentz was potentially exposed to asbestos in the early 1960s during cleanup of construction sites and removing pipes from the basement of an abandoned hospital. Even though these were dusty applications, he does not recall wearing a respirator. He also performed brake and clutch work over several years.

From 1978-1981 Mr. LaFrentz worked for General Dynamics at the Carswell Air Force Base where he drilled, sanded and deburred coupons (strips and panels) for testing. Each coupon took approximately 15-40 minutes. Mr. LaFrentz indicated that he did this work intermittently (e.g. 1 or 2 days a month) but processed at least 1000 coupons over the 3 year period. He would also clean up his station with a small broom and compressed air hose. There was no local exhaust ventilation and they were not allowed to wet the material to keep down the dust levels.

LaFrentz testified that respirators were not required by General Dyamics for his work. He was not aware of the materials or composition of the coupons. After a period of time, he "told the parts guy that...I needed a dust mask for all that dust." He claims to have been given the 3M 8710 but did not receive any training on the use or fitting. LaFrentz never saw any advertisement, literature, warnings or instructions for the 3M 8710.

He complained about the dust levels and smell to his supervisor, but no changes were made. On 2/26/80 a one minute air sample taken while Mr. LaFrentz was "Belt Sanding P 653 Panels" indicated 28.8 asbestos fibers/cc. This was above the 10 f/cc ceiling limit, but the safety engineer made no comments about the results or his respirator, and no changes were made. LaFrentz claims that at that time he didn't know what asbestos was or the associated health hazards. He doesn't recall discussion of asbestos at weekly safety meetings.

Other OSHA standards and good industrial hygiene practice dictate that employees must be trained on workplace hazards and their potential health effects. OSHA, NIOSH and other groups have published mandatory requirements and/or best practices for controlling worker exposure to asbestos, silica, coal dust and many other substances. Based on the documents provided to me, neither hazard communication, exposure control methods nor a respiratory protection program were properly implemented.

If additional depositions are taken, other experts raise issues or additional information becomes available, I may offer other opinions if they are within my scope of expertise and practice. This may include review of additional materials and documents.

<u>QUALIFICATIONS AND PUBLICATIONS</u>: A copy of my curriculum vitae is attached, which lists my qualifications and publications.

TESTIMONY: A list of cases in which I have testified as an expert at trial or by deposition during the last four years is attached.

COMPENSATION: I am not being compensated beyond my normal salary.

Erik W. Johnson

8/12/20

Date

ERIK JOHNSON, MPH, CIH, CSP

Erik Johnson is a Technical Service Specialist with the Personal Safety Division of 3M Company. He has worked for the past 25 years with this Division. His current responsibilities include product development and stewardship, technical writing, and public speaking. Previously his focus was technical service for the Asia/Pacific region.

Erik holds a Bachelor of Arts Degree in Physics from St. Olaf College in Northfield, Minnesota and a Masters Degree in Public Health with emphasis in Industrial Hygiene from the University of Minnesota. He is a certified industrial hygienist and certified safety professional.

PUBLICATIONS:

Checky M, Frankel K, Goddard D, Johnson E, Thomas JC, Zelinsky M, Javner C. "Evaluation of a passive optical based end of service life indicator (ESLI) for organic vapor respirator cartridges." J Occup Environ Hyg. 2016; 13(2):112-20. 2016

Cho, H., Yoon, C. Lee, J., Lee, S., Viner, A. Johnson, E. "Comparison of Pressure Drop and Filtration Efficiency of Particulate Respirators using Welding Fumes and Sodium Chloride." *Ann. Occup. Hyg* 55(6): pp. 666-680, 2011.

Reponen, T., Lee, S., Grinshpun, S. Johnson, E., McKay, R. "Effect of Fit Testing on the Protection Offered by N95 Filtering Facepiece Respirators Against Fine Particles in a Laboratory Setting." *Ann. Occup. Hyg* 55(3): pp. 264-271, 2011.

G. Ramachandran, E.W. Johnson and J.H. Vincent "Inversion Techniques for Personal Cascade Impactor Data." *J. Aerosol Sci.* 27, 1083-1097, 1996.

PRESENTATIONS:

E.W. Johnson. "Construction Silica Competent Person" Various locations. 2017.

E.W. Johnson "A Breath of Fresh Air: OSHA Respirator Standard 29 CFR 1910.134" ASSE, Denver, 6/22/2017

E.W. Johnson "PAPR Cartridge Service Life Against Hydrogen Peroxide and Peracetic Acid" AIHCE, Seattle 6/5/2017

E.W. Johnson "Permeation and Respiratory Protection", AIHA, State College PA 4/6/2016

E.W. Johnson "Developing Respirator Cartridge Change Schedules" AIHA webinar 3/10/2015

E.W. Johnson “Carbon Loaded Disposable Respirators: Intended Use and Capabilities” American Industrial Hygiene Association and Exposition, San Antonio, TX, 2014.

E. W. Johnson “Respirator Cartridges and Filters: How Do They Do What They Do” Voluntary Protection Programs Participants' Association, Nashville TN, 2013 and Washington DC, 2014.

E.W. Johnson “Respiratory Protection for Healthcare Workers” Occupational Safety + Health Asia, Singapore, 2008.

E.W. Johnson “Respiratory Protection and Engineered Nanoparticles” Occupational Health & Safety Industry Group, Auckland, New Zealand, 2008.

E.W. Johnson “Filtration Efficiency of Surgical Masks and Particulate Respirators Against Biological Aerosols” International Society for Respiratory Protection, Toronto, Canada, 2006.

E.W. Johnson “Long Term Diffusive Sampling: Literature Review and Testing” American Industrial Hygiene Association and Exposition, San Diego, CA, 2002.

E.W. Johnson and L.A. Brey. “Prediction of the Effect of High Relative Humidity on Organic Vapor Cartridge Performance” American Industrial Hygiene Association and Exposition, New Orleans, Louisiana, 2001.

E.W. Johnson and L.A. Brey “Prediction of Respirator Cartridge Service Life Against Organic Vapors at Workplace Concentrations” American Industrial Hygiene Association and Exposition, Atlanta, Georgia, 1998.

E.W. Johnson, D.J. Larsen and R.A. Weber. Performance Evaluation of Organic Vapor Diffusion Monitors. Presented at the American Industrial Hygiene Conference and Exposition, Washington D.C., 1996.

D.J. Larsen and R.A. Weber and E.W. Johnson. Storage Characteristics of Exposed Activated Carbon Diffusion Monitors. American Industrial Hygiene Conference and Exposition, Washington D.C., 1996.

E.W. Johnson. Respiratory Protective Devices. Filtration ‘95 International Conference & Exposition, Chicago, IL. 1995.

E.W. Johnson. Laser Surgery Plume as a Particle Source. American Filtration Society, Minneapolis, MN, 1994.

E.W. Johnson and J.H. Vincent. A Study of Two Personal Cascade Impactors and Their Potential for Application in Health-Related Aerosol Exposure Assessment. Fourth International Aerosol Conference, Los Angeles, CA, 1994.

CONTACT INFORMATION:
Address: 3M Center, Bldg. 235-2E-91, St. Paul, MN 55144
Phone: 651-737-2713
E-mail: erikwjohnson@mmm.com

Deposition and Trial Testimony of Erik Johnson, C.I.H.

Testimony:	Expert/30(b)6	Date:	Case:
Deposition	Expert	8/13/2020	*Larry L. Roemmich and Gloria Roemmich, Husband and Wife* Case No. 20-2-00926-1-KNT Superior Court of Washington, King County
Deposition	Expert	1/24/2020	*Alfred M. Burton v. 3M Company, et al.* *Case No. 19-2-17070-1-KNT* *Superior Court of Washington for King County*
Deposition	Expert	8/29/2019	*Valerie Jean Culver, as Personal Representative of the Estate of Robert D. Larson, Deceased, and Bessie Larson v. 3M Company, et al.* Case No. 18-2-03806-5-SEA Superior Court of Washington, King County
Deposition	Expert	8/28/2019	*Wayne Wright, Individually and as Personal Representative for the Estate of Warren Wright, Deceased v. 3M Company et al.* Case No. 18-2-03806-5-SEA Superior Court of Washington, King County
Deposition	30(b)6	5/31/2019	*Robert Miller and Janice Miller v. 3M Compan* Case No: 2-18-cv-00510-JAW USDC, District of Maine
Deposition	Expert	4/29/2019	*Randolph Morton and Edna Morton v. 3M Company* Case No. 702643 Superior Court of the State of California, County of Los Angeles
Deposition	Expert	2/21/2019	*Richard W. Lewis and Diane J. Lewis v. 3M Company, et al* Case 18-2-09747-4 Superior Court of Washington for Pierce Cou
Deposition	Expert	1/29/2019	*Terry Coleman, et al., v. 3M Company* *Case No. 16-CI-238* *David Allen, et al., v. 3M Company* *Case No. 16-CI-159* Knott County Circuit Court
Trial	Expert	12/14/2018	*Ida McCarthy, as Personal Representative of the Estate of Gerald T. McCarthy* Case No. 15-5621 Commonwealth of Massachusetts, Middlesex Superior Court
Deposition	Expert	11/1/2018	*Ida McCarthy, as Personal Representative of the Estate of Gerald T. McCarthy v. 3M Company* Case No. 15-5621 Commonwealth of Massachusetts, Middlesex Superior Court
Deposition	Expert	8/29/2018	*Richard Adams (Gaddy Hall) v. 3M Company* Case No. 15- CI-00310 Commonwealth of Kentucky, Letcher Circuit Court
Deposition	30(b)6 (Confidential)	11/28/2017	*Jackie D. Earls Jr., and Donna Earls v. 3M Company* Case No. 10-010111 In the Court of Common Pleas of Allegheny County, Pennsylvania

*Erik Johnson is an employee of 3M Company, there is no charge for his testimony.

Exhibit B

Dennis J. Seal, Ph.D., P.E.
Seal Design & Engineering, Inc.
Human Factors and Product Safety
6461 Lake Circle Drive
Dallas, Texas 75214

Mr. Daniel C. Adams **13 August 2020**
Larson & King, LLP
Attorneys at Law
2800 Wells Fargo Place
30 East Seventh Street
Saint Paul, Minnesota 55101-4922

Re: J. LaFrentz, et al v. 3M Company, et al
United States District Court-Southern District of Houston Division
Civil No: 4:18-cv-4229

Mr. Adams,

Per the request of your office and as a Professional Engineer (Texas No. 79090), I have been asked to investigate both the human factors and industrial safety areas of the above-referenced case. The primary issues in this case include (but are not limited to) employee exposure to asbestos materials and the methods, engineering processes, employee training and safety information as related to respiratory protection. The opinions expressed are based on my education and experience in relevant areas of human factors and product safety engineering and my review of materials available to me at the date of this report. I am being compensated for my expert services on an hourly basis of $320.00 per hour.

I have been requested to investigate issues of this case and specifically address human factors elements as these areas of my expertise relate to safety analysis and hazard identification, job analysis and risk mitigation, employee training, warnings and safety labels, product packaging and advertisements as well as employee behavior and work practices.

My professional qualifications include the following:

(1) Total of 40 years developing and testing human factors and safety standards as well as applying engineering design criteria for industrial, governmental and aerospace applications, consumer product designs, development of warnings and instructional materials and the enforcement of occupational safety.

(2) Member of the original American National Standards Institute (Z535.1-5) committee responsible for published standards for warning labels, safety symbols, environmental signage, user manuals and related hazard mitigation criteria. The basis of the usage of warnings paralleled the adoption of these ANSI standards.

(3) Academic teaching assignments at the University level in applied areas of human factors, information processing theory, product safety, risk mitigation practices, research and test methodology and industrial engineering.

(4) Development and enforcement of OSHA 1910 training programs including the implementation of Hazard Communication (HAZCOM) Programs, employee training and the use of facility warnings and product labels at Fortune 500 Companies.

(5) Supervision of the design, production and distribution of safety information (labels and technical instructions) for various forms of human interfaces including consumer products, avionic warning systems, heavy machinery, highway signage, manufacturing environments and safety equipment.

(6) Extensive research and published materials for corporate safety programs including, but not limited to, equipment safety warnings, technical manuals, safety literature, hazard analysis, risk mitigation and hazard resolution methods.

A complete listing of my professional areas of expertise and affiliations are detailed on the attached CV, including a Summary of my Areas of Specialization. A Rule 26 reference list of case testimony is available upon request. A brief summation of my education and professional experience is detailed below.

I received my Bachelor's degree from the University of Cincinnati and Master's degree in Experimental Psychology and Statistics from Texas A&M University. I continued my graduate studies and research programs at Texas A&M University in College Station, Texas culminating in the Doctorate degree in Industrial Engineering in 1980. I currently hold Professional Engineering licenses in the states of Texas (No. 79090) and Wyoming (No. 15888). While in graduate school I prepared scientific proposals and was funded by different agencies to conduct research while applying statistical calculations and reporting results on topics ranging from information processing, memory and learning, safety instructions, technical manuals, signage and various forms of "hazard alert" messages. These research projects led me into other scientific and engineering fields of application where I participated in the design of consumer products (as a member of the design staff) for clients contracted with the Industrial Design firm, Henry Dreyfuss Associates, in New York City. Our firm designed many different commercial products including the original automated teller machines (ATMs) for Citicorp, aircraft interiors for Falcon Jet and American Airlines, workspace environments for AT&T/Bell Laboratories, as well as John Deere industrial and agricultural machinery. It was during this early stage of my career that I acquired the foundation methodology of identifying product hazards and specifically while working alongside corporate engineering and manufacturing departments. It was my responsibility to review drawings, product models and prototypes and to identify specific hazards unique to these products and develop risk mitigation processes. The determinations to use warnings, as an alternate method of mitigation, were based on engineering analyses addressing calculated probabilities of occurrence, severity of risk and the scientific determination of potential risk(s) of each identified hazard. I have continued over the span of 40 years to use the same scientific processes for determining the usage of warnings in each of the following categories:

1. **Mechanical:** powered tools, industrial machinery, aircraft components;
2. **Chemical:** known and established carcinogens (e.g. PVC, asbestos);
3. **Electrical**: electrical power systems; mission equipment, navigation equipment;
4. **Environmental:** manufacturing facilities, industrial hazards, fire suppression systems;
5. **Consumer products:** firearms, hand tools, sporting equipment and entertainment products.

WARNINGS: American National Standards Institute (ANSI Z535.1-5)

During my affiliation with Henry Dreyfuss Associates and our design contracts with different product manufacturers, I was invited to become a member of the ANSI Z535.1-5 Committee to participate in the development of specific criteria for safety warnings, determination of use, required format, verbiage, graphics and colors. The ANSI Z535.1-5 Specifications were adopted as industry standards in 1991 and established the fundamental criteria for (1) the determination of hazard avoidance and warning applications; (2) recommended signal words (i.e. DANGER, WARNING, CAUTION), (3) graphical format and font size, as well as content of the label, and symbols or safety instructions (based on Human Factors criteria). For commonality purpose, ANSI collaborates internationally with ISO, the International Organization for Standardization, in efforts to protect consumers and end-users of products by applying the same class of warning standards for recognition, comprehension and ultimately the avoidance of "identified" hazards."

As a member of the ANSI Committee and throughout my professional engineering career, I have used the same methodology, statistical test procedures and methods of determination to identify the need for warning labels. On behalf of product manufacturers of machinery, power tools, chemicals, work environments, recreational products and other commercial products I have determined the "need" for safety warnings and subsequently developed specific warnings for manufacturers based on established ANSI criteria. Throughout my career, I have consulted in many litigated matters defending the use and adequacy of warnings used by manufacturers and have supported plaintiffs injured while using products where I have determined the use of warning labels were necessary and likely would have prevented injury or fatal consequences.

The opinions and conclusions documented in this report are based on my review of safety literature pertaining to occupational hazards while working in operations with the potential of creating asbestos dust. James LaFrentz worked various jobs over his lifetime beginning in the summer months of high school and continuing many years while working for General Dynamics/Lockheed beginning in 1979 until his retirement in 2005. LaFrentz worked different job assignments which more likely than not exposed him to asbestos dust.

For purposes of case evaluation and my summary of opinions, I have reviewed published literature as related to engineering controls, benefits of respiratory protection and documents pertaining to warnings, safety regulations and respiratory protection standards. I have also reviewed case specific legal documents including plaintiff's complaint and employment records. Specifically, in preparation of this report I have reviewed the following materials:

(1) Plaintiff's First Amended Complaint;
(2) Plaintiff's Second Amended Complaint;
(3) Plaintiff's Verified Amended Complaint;
(4) Plaintiff's Third Supplemental Rule 26(a) Disclosures;
(5) Plaintiff's expert reports of Darrell A. Bevis filed on 06/23/2020, and Kenneth S. Garza filed on 06/12/2020;
(6) Deposition transcripts of James LaFrentz Vol I, taken 11/14/2018 with Exhibits; J. LaFrentz Vol II, taken 11/15/2018 with Exhibits;
(7) Plaintiff LaFrentz's Employment and Medical records;
(8) Government Standards and Regulations (as related to respiratory protection and workplace safety): OSHA (29 and 30 CFR), 42 CFR Part84, ANSI Z535, NIOSH;
(9) The 3M Model 8710 respirator and related packaging materials for relevant employment periods of James LaFrentz.

CASE BACKGROUND

Plaintiff James LaFrentz has alleged asbestos exposure during his employment years of 1979-2005 as an employee, initially with General Dynamics (GD) and retired from Lockheed Martin (in a purchase/merger arrangement). LaFrentz began work as a "drill press operator" in the parts fabrication department at GD. LaFrentz was assigned to the F-16 aircraft program and was responsible for drilling coupons/panels composed of honeycomb and metal plating. LaFrentz drilled ½" holes into the aluminum test panels which contained an asbestos containing material (ACM) applied for thermal transfer purposes. After drilling the holes LaFrentz would sand the panels using a small belt sander or a 'whirligig' to deburr the holes and surfaces of the panels.

During his deposition testimony Mr. LaFrentz was asked if his job of drilling the test panels created any dust and his response was, "Yes, very much so. It was very, very dusty….I saw the dust with my own eyes and had to wipe it off my face." (Deposition testimony of J. LaFrentz, Vol. 1, Page 69, Lines 1-9 and Lines 20-24) Mr. LaFrentz testified that when he first started drilling coupons, he "did not remember if he wore a mask, but doesn't think he did." LaFrentz stated he was never told he could be exposed to asbestos and that approximately 30-40 other GD employees were doing similar work in his assigned department. According to LaFrentz, no other employees wore masks in the parts fab department "while I was drilling or sanding the coupons." (Deposition testimony of J. LaFrentz, Vol I, Page 88, Lines 5-9)

LaFrentz testified he was also responsible for the "massive cleanup" once he completed a "bin of panels." LaFrentz would use a long-handled brush and clean his desk off (of dust) and if the panels were still dusty, he would use an air hose to blow dust off the test panels. He then used the brush to clean up the floor. (Deposition testimony of J. LaFrentz, Vol. 1, Page 88, Lines 11-20) According to Mr. LaFrentz's testimony, he did not wear a mask when he began working at GD and subsequently began to wear a mask when he realized how much dust his job created. Other employees in the parts fab department did not always wear a mask, there were no policies in place to use a mask." (Deposition testimony of J. LaFrentz, Vol. 1, Page 74, Lines 1-4)

LaFrentz has testified there was no safety training, fit-checking of masks, and never any enforcement at GD/Lockheed to wear any form of respiratory protection. LaFrentz was not aware of what products contained asbestos, what asbestos was or what the long-term risks were associated with asbestos dust exposure. General Dynamics did not instruct, or train its employees of the health risks associated with asbestos exposure. According to LaFrentz, he was not aware of "asbestos risks" or the potential of related diseases until approximately 1996 when a facilitator (at General Dynamics) "came down with mesothelioma." (Deposition testimony of J. LaFrentz, Vol. 1, Page 93, Lines 11-16)

It is my opinion Mr. LaFrentz was not aware of the asbestos dust hazards in his work environments while assigned the above referenced jobs at General Dynamics. According to his testimony, LaFrentz was never informed he was working with asbestos products or that asbestos products were a risk to his health. Though he claims to have not worn a mask when he first began working in the parts fab department, he also testified he began wearing a mask ("he thought was the 8710") when he would drill and deburr test panels. LaFrentz testified there were no respiratory protection policies in place at GD/Lockheed, and he had not reviewed any mask brochures, seen any advertisements, instruction sheets or warnings or other literature of any kind relative to respirator usage in his workplace. Although GD did hold 30-minute safety meetings each week, he did not recall any discussion concerning "hazards of asbestos dust." (Deposition testimony of J. LaFrentz, Vol. 1, Page 95, Lines 2-22)

Although air sampling had been conducted at General Dynamics in February of 1980, the test results had not been communicated advising employees of test results or of any health hazards. The designated GD safety engineer had collected workplace air samples and recorded concentration levels as high as 28.8 f/cc in the parts fab shop when the allowable limit (PEL) was 2.0 f/cc (Ex 2 of plaintiff's file). Mr. LaFrentz was made aware of these test results but any related health implications were never communicated to GD/Lockheed employees as required by OSHA 1910 regulations. Mr. LaFrentz stated that he first became serious about his health and personal workplace safety when a facilitator at GD became sick with mesothelioma in 1996. "It was at this time I realized what asbestos was." (Deposition testimony of J. LaFrentz, Vol. 1, Page 93, Lines 3-16)

There is lack of evidence demonstrating that the employers of James LaFrentz, while employed at GD/Lockheed (or other places of employment) adopted the required safety programs with the intent of **(1)** alerting their employees to risks associated with asbestos dust exposure, **(2)** providing suitable respirator protection (in accordance with applicable standards with respect to usage, fit tests and checks, maintenance and training, **(3)** adopting suitable engineering dust controls as well as, **(4)** continually monitoring the work environment while assessing the degree of employee exposure to asbestos dust.

Relative to defendant 3M I have been asked to review the information contained on the packaging of the 3M Model 8710 respirator as well as other safety information for the relevant employment periods of Mr. LaFrentz. It is my opinion that the 3M respiratory devices do not present any risk of hazard to the users of this safety product. Based upon the information I have reviewed any workplace hazards to which Mr. LaFrentz was exposed were not caused by 3M products. It is more likely than not that the workplace environments, including product related materials (i.e. ACM) and the job operations performed by LaFrentz were the sources of asbestos exposure.

The safety literature in the area of warnings has demonstrated that warnings and safety instructions are most often ignored if the employer does not instruct employees and inform them of workplace hazards. The perception of a specific hazard and the associated levels of risk are the primary motivators for a change in behavior, i.e., the use of proper respiratory protection. Numerous studies in the areas related to warnings and safety label efficacy demonstrate the greater the perceived level of risk the greater the motivation to avoid the identified hazard. Fundamental to this finding is the premise that the "risk level" and "hazard level" must be known. Employees must be trained and made aware of specific hazards in their working environment. It is my expert opinion that Mr. LaFrentz did not receive appropriate hazardous training and specifically not with respect to the hazards of asbestos dust and the need for proper respiratory protection. LaFrentz was not aware of the severity of risk associated with asbestos dust exposure and the mitigation methods (e.g. substitute materials, engineering dust controls) that must be established and implemented by his employers. The hazard identification and resolution process, including related training programs, are the responsibility of the employer and must be enforced for maximum employee safety.

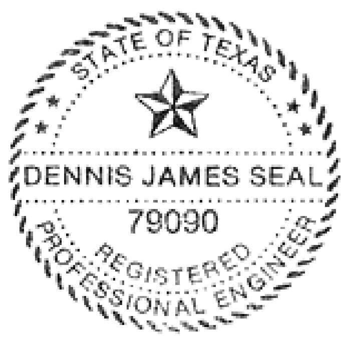
In summary of my opinions, 3M 8710 respirators do not present a personal risk of hazard. Since not presenting a personal risk of hazard, I am of the opinion that the 3M 8710 respirator would not require warnings, either on the packaging or the product itself. Furthermore, it is my expert opinion that the 3M packaging for these products, including the instructions and limitations, were appropriate in design, content and presentation during relevant times of Mr. LaFrentz's employment.

Warnings, safety instructions, and use limitations are forms of communication for alerting employees to potential hazard risks in the working environment. The product packaging for the 3M respirators during the relevant times included appropriate safety information addressing "uses and limitations." However, the efficacy of such warnings and packaging information is dependent upon the employee's awareness of a specific hazard and the risk level of each known hazard. Employers must identify each workplace hazard and train employees accordingly and must first work towards using non-toxic materials, secondly, adopting engineering controls (e.g. dust removal methods) and lastly relying on the temporary use of respiratory protection when exposure limits are exceeded.

This report is based on case specific documents as described earlier, including industry-accepted publications and journal published literature. I reserve the right to revise the expressed opinions should additional materials become available.

Respectfully Yours,

Dennis J. Seal, Ph.D., P.E.
Seal Design and Engineering, Inc.
Human Factors/Product Safety



Dennis J. Seal, Ph.D., P.E.
Seal Design and Engineering, Inc.
6461 Lake Circle Drive
Dallas, Texas 75214
Office: 214 823-9364
Cell: 214-734-3708
e-Mail: djseal@sbcglobal.net

EDUCATION:

Ph.D., Industrial Engineering/Human Factors and Product Safety
Texas A&M University, College Station, Texas, 1980
M.S., Experimental Psychology/Information Processing & Learning
Texas A&M University, College Station, Texas, 1974
B.A., Psychology, University of Cincinnati, Cincinnati, Ohio, 1972

PROFESSIONAL EXPERIENCE:

L-3 Com/AIRBORNE INTEGRATION SYSTEMS, INC. 1985 – Present
Airborne Integration, Inc., Waco, Texas
(Formerly Raytheon Systems and Chrysler Technologies)
Richardson, Texas
Senior Principal Engineer: Human Factors and Product Safety

- Director of Human Factors and Safety Engineering for all Corporate Programs
- Conduct research and qualification tests to support program efforts in product development and subsystem design and integration.
- Apply Human Factors and Safety criteria in the design of visual displays and controls, workstation layouts, aviation systems, hazard identification and risk mitigation, warnings and alerting devices, software and technical user manuals, and operator/maintainer environments.
- Establish program plans, test procedures, and analyze test data and report results in technical documentation and/or at scheduled Design Reviews (e.g. PDR, CDR, TIMs).
- Prepare/manage budget and technical documentation for contract proposals.
- Establish/maintain Corporate Hazard Communication Programs (OSHA 1910) for employee training in safety and health, including workstation evaluations, facility safety, HAZCOM initiatives, lift/weight issues, safety warnings and training.
- Integrate human engineering and safety criteria with mechanical and electrical engineers, software programmers, environmental test, quality control, and manufacturing departments during each appropriate design phase.

TEXAS INSTRUMENTS, INC., Dallas, Texas 1983 – 1985
Director, Human Factors/Ergonomics – Consumer Products

- Managed Human Factors Department for new product design, personnel staffing, administration and budget, product development activities, and test laboratory.
- Organized sample populations, methodology and research efforts for prototyped product tests (e.g. keyboards, joystick controls), analyzed results, and articulated production recommendations to the design staff.
- Establish Corporate Ergonomic product design criteria for U.S. and Japan Product Centers.
- Integrated Human Factors design criteria with Industrial Design, Graphics, Software, Marketing, Packaging, and Manufacturing staffs.

HENRY DREYFUSS ASSOCIATES, New York, New York 1979 – 1983
Senior Human Factors Engineer – Industrial Design/Consumer Products

- Project activities included implementing human factors and safety requirements for consumer product designs. Also conduct research and pilot studies, as well as evaluate scaled mock-ups and prototypes in support of new product development.
- Worked closely with clients (e.g. AT&T, Falcon Jet, John Deere and Company, CITICORP, LearJet, Polaroid, and American Airlines) during all phases of product design to ensure human factors, safety and ergonomic requirements were implemented in final production.
- Served as a committee member of American National Standards Institute (ANSI Z535) for the purpose of establishing industrial standards based on human perception, detection, and comprehension of displayed information for warnings, symbols, and visual displays. Standards were adopted in 1991 for industry-wide use on commercial and industrial products.

SOUTHERN METHODIST UNIVERSITY, Dallas Texas 1985 – 1986
Adjunct Professor, Human Factors and Industrial Ergonomics
Operations Research and Engineering Management Department
Taught Human Factors/Product Safety courses to undergraduate and graduate level students.

TEXAS A&M UNIVERSITY, College Station, Texas 1977 – 1979
Visiting Instructor, Department of Psychology
Taught courses in Introductory, Industrial and Developmental Psychology to undergraduate and graduate level students.

DEPARTMENT OF TRANSPORTATION, Austin, Texas 1977 - 1979
Project Coordinator; Governor's Office of Traffic Safety

- Program Manager for D.O.T. project evaluating interactive effects of vehicular design, vibration/noise levels, highway design, perceived rates of speed, and comfortable driving speeds.
- Responsibilities included proposal preparation, contract and budget coordination, supervising research assistants, data analysis, organizing progress reports, and presenting the findings to the Department of Traffic Safety.

TEXAS TRANSPORATION INSTITUTE, College Station, Texas 1975- 1977
Research Assistant, Texas A&M University

- Conducted studies to aid in the design and implementation of real-time information displays that were used on urban freeways and parallel alternative routes.
- Display designs were based on information processing theory, visual recognition, conspicuity and reaction times of drivers during simulated highway driving maneuvers.
- Results of study were used to publish the Texas Manual on Uniform Traffic Control Devices (for streets and highway application).

CURRENT RESPONSIBILITIES:

Director of Human Factors/Ergonomics and Product Safety engineering for corporate engineering. Engineering programs include systems design, product development and qualification tests, subsystem components, product designs and integrations, facility safety, aircraft modifications and airborne communication systems.

As facility human factors and safety engineer responsibilities include continued compliance to OSHA HAZCOM, Environmental Protection Agency (EPA), National Institute of Occupational Safety and Health (NIOSH), American Disabilities Act (ADA), and American National Standards Institute (ANSI).

Also responsible for site surveys, product and systems evaluation, hazard identification, safety warnings (ANSI Z535), and hazard resolution applications at all engineering, production and manufacturing phases.

Primary functions on engineering programs include workstation environments and component interface designs, anthropometric/operator studies, lighting and acoustic measurements, operator tasks and behavioral analyses, warnings, user manuals and training, design of controls and visual displays, safety and health reviews, mock-ups and prototype evaluations, ergonomic analyses, software applications, and final system integration and qualification tests.

AREAS OF INTEREST:

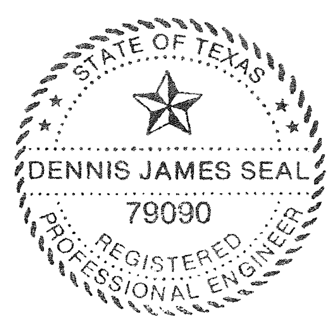
Product functionality and safety, product testing and qualification, mission-control environments; information processing theory and learning; hazard identification/resolution; warnings/signs and labels; quantitative methods; human factors in aviation; transportation safety.

PROFESSIONAL MEMEBERSHIPS:

Registered Professional Engineer, State of Texas (P.E. 79090)
Human Factors and Ergonomics Society
Ergonomics/Occupational Safety and Health
American National Standards Institute (ANSI)
Consumer Product Safety Commission (CSPC)
Electronic Industries Association (EIA G-45)
Aircraft Owners and Pilots Association (AOPA)

SECURITY CLEARANCES:

TOP SECRET (Active)
COMSEC (Active)



Dennis Seal's Deposition and Trial Testimony
2009-2020

SEAL[1]	**DATE**	**CASE**
Deposition	3/13/2009	*Denton Crull, et al. v. A. W. Chesterton Company, et al.* *Case No. RG0840466* Alameda County, California
Deposition	3/30/2009	*John Scarduzio v.3M Company, et al.* *Case No. 08-L-643* Madison County , Illinois
Deposition	3/18/2011	*William R. Dennis, v. Asbestos Defendants (B P)* Case No. CGC-09-275157 San Francisco County, California
Deposition	5/7/2015	*Jessie Gray v. 3M Company, et al* *13-PL-CC00036* *Pike County*

[1] Seal's Hourly Fee: $320

Deposition	2/19/2016	*Elsa Clementir v. 3M Company, et al* *BC506479* *Los Angeles County*
Deposition	2/19/2016	*Elsa Clementir v. 3M Company, et al* *BC506479* *Los Angeles County*
Deposition	5/12/2016	*Fred Hill, et al. (Estate of Marion Russell Reynolds)* Case No. 05-C1-00589 Commonwealth of Kentucky, Perry Circuit Court
Deposition	7/13/2016	*Van Michael Parker v. 3M Company* Case No. 15-369-NJR-PMF United States District Court, Southern District of Illinois

Deposition	3/1/2017	*John F. Collins, et al., v. 3M Company* *C.A. NO. 10-CI-00176* *COMMONWEALTH OF KENTUCKY* *KNOTT CIRCUIT COURT*
Deposition	3/30/2017	*Shirley Broussard v. 3M Company* *Case: 1:16-CV-00462-SHE* *United States District Court* *Eastern District of California*
Deposition	12/29/2017	*Angel Rigor v. 3M Company* Case No: BC660976 Superior Court of the State of California, County of Los Angeles
Deposition	1/26/2018	*Burnis Hall (Leslie Cox and Michael Cox) v. 3M Company* Case No. 16-CI-00100 Commonwealth of Kentucky, Knott Circuit Court

Deposition	2/16/2018	*Fred Williams v. 3M Company* Case No. 16-CI-01061 Commonwealth of Kentucky, Pike Circuit Court
Deposition	10/8/2018	*Ida McCarthy v. 3M Company* *Case No. 15-5621* Commonwealth of Massachusetts, Middlesex Superior Court
Trial	12/17/2018	*Ida McCarthy v. 3M Company* *Case No. 15-5621* Commonwealth of Massachusetts, Middlesex Superior Court
Deposition	1/10/2019	*Terry Coleman, et al., v. 3M Company* *Case No. 16-CI-238* *David Allen, et al., v. 3M Company* *Case No. 16-CI-159* Knott County Circuit Court
Deposition	2/15/2019	*Richard W. Lewis and Diane J. Lewis v. 3M Company, et al* Case 18-2-09747-4 Superior Court of Washington for Pierce County
Deposition	4/11/2019	*Dennis Slone and Corbin Burke v. 3M Company* Case No. 17-CI-00846 Commonwealth of Kentucky, Pike Circuit Court

Deposition	6/7/2019	*Apostolos Agrios, an Individual; Ann Agrios, an individual, v. 3M Company* Case No. BC -715172 Superior Court of the State of California, County of Los Angeles
Deposition	9/6/2019	*Valerie Jean Culver, as Personal Representative of the Estate of Robert D. Larson, Deceased, and Bessie Larson v. 3M Company, et al.* Case No. 18-2-03806-5-SEA Superior Court of Washington, King County
Deposition	9/6/2019	*Wayne Wright, Individually and as Personal Representative for the Estate of Warren Wright, Deceased v. 3M Company et al.* Case No. 18-2-03806-5-SEA Superior Court of Washington, King County
Deposition	8/7/2020	*Larry L. Roemmich and Gloria Roemmich, husband and wife* Case No. 20-2-00926-1-KNT Superior Court of Washington, King County

Exhibit C

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF TEXAS
HOUSTON DIVISION
CIVIL NO.: 4:18-cv-4229

ILA LaFRENTZ, JIM LaFRENTZ, KATHERINE PORTERFIELD, and WILLIAM LaFRENTZ, Individually and as Representatives of the Estate of JAMES LaFRENTZ, PLAINTIFFS

vs.

3M COMPANY, ET AL., DEFENDANTS.

Report of Philip D. Eitzman, Ph.D., Ila LaFrentz, et al. vs. 3M Company, et al.

This report represents my opinions relating to the case of Ila LaFrentz, Jim LaFrentz, Katherine Porterfield and William LaFrentz, Individually and as Representatives of the Estate of James LaFrentz vs. 3M Company, et al., in United States District Court in the Southern District of Texas (Civil No. 4:18-cv-4229). My opinions are based on the available information that I have reviewed to-date. In the event that I am provided with additional information, I may have additional or supplemental opinions.

I am currently an employee of 3M Company and have been continuously employed by 3M since 1991. My current assignment is as a Division Scientist in the Personal Safety Division (PSD). Since 1994, I have worked on many aspects of the development and production of 3M disposable respirators, including filter media development, respirator design, manufacturing equipment design and quality control. I hold numerous patents related to respirator filter media and disposable respirator design. I received a B.S.Ch.E. in Chemical Engineering from the University of Florida in 1986. I received a Ph.D. in Chemical Engineering from the University of Minnesota in 1992.

My opinions are based on my education, training and experience and on my review of various 3M documents and data, the testimony and opinions of various 3M lay and expert witnesses, scientific publications, texts and studies, the pleadings and other documents and evidence in this case.

The complaint in this case alleges that James LaFrentz, deceased, was exposed to airborne asbestos while working as a machinist at a General Dynamics aircraft plant located in Fort Worth, Texas. According to Mr. LaFrentz's testimony in deposition, the work that resulted in his alleged exposure involved drilling and sanding samples of aircraft panels or "coupons" in preparation for tests conducted by other employees of

General Dynamics. In further testimony, he indicated that his alleged exposure to airborne asbestos resulted from his preparation of coupons that occurred sometime between 1979 and 1982. Mr. LaFrentz testified that he wore 3M 8710 respirators while preparing coupons during this time except for a period of one or two weeks in 1979.

It is my opinion that government-approved 3M respirators, such as the 3M 8710, could have been used as part of a properly-run respiratory protection program to reduce workers' exposure to various dusts. It is also my opinion that 3M has provided instructions for effective fit tests and user seal checks for its government-approved disposable respirators, including the 3M 8710. If Mr. LaFrentz's employer was following applicable OSHA regulations, including requirements for monitoring the workplace, for the selection of respiratory protection equipment and proper training of workers, and that program included the 3M 8710 respirator it is my opinion that his exposure to asbestos dust would have been reduced to below the permissible exposure limit (PEL). In 1986, OSHA regulations changed and no longer allowed the use of single-use respirators, which includes the 3M 8710 respirator, to reduce workers' exposure to airborne asbestos.

It is my opinion that the manufacturing processes and quality control procedures used by 3M in the manufacture of the NIOSH-approved 3M respirators, such as the 3M 8710, were reasonable and met all requirements of the respirators' approval under 30 CFR 11. I may testify about the design and manufacture of the NIOSH-approved 3M respirators and their component parts. I may also testify regarding the quality control systems and quality control practices used by 3M in the manufacture of 3M respirators.

I expect to testify about the testing of 3M disposable respirators per the requirements of 30 CFR 11, including the testing of those respirators with silica dust aerosol. My testimony regarding 30 CFR 11 may include the respirator approval process and the specific requirements for the approval of single-use dust masks.

In my opinion 3M 8710 respirators and other approved 3M respiratory protection equipment were and are appropriately designed and reasonably safe for their intended uses.

I may offer additional testimony concerning any issue raised by other experts or any other party in this case or any other relevant documents that become available, provided those opinions are within my fields of expertise.

My opinions expressed in this report are also based on case-specific materials provided to me which included the following:

1. Deposition transcript of James LaFrentz, taken 11/14/2018;

2. Deposition transcript of James LaFrentz, taken 11/15/2018;

3. Exhibits to the depositions of James LaFrentz;

4. Plaintiffs' Third Supplemental Rule 26(A) Disclosure;

5. Expert Report of Darell Bevis;

6. Expert Report of Ken Garza;

7. Plaintiffs' Second Amended Complaint

Dated:August 13, 2020

Philip D. Eitzman, Ph.D.

3M PERSONAL SAFETY DIVISION LABORATORY
3M CENTER BLDG 235-2E-57 • MAPLEWOOD, MN 55144
PHONE 651-733-3483 • FAX 651-737-3069 • E-MAIL PDEITZMAN2@MMM.COM

PHILIP D. EITZMAN, PH.D.

EDUCATION

1982 - 1986 University of Florida Gainesville, FL
B.S.Ch.E. in Chemical Engineering

1986 - 1992 University of Minnesota Minneapolis, MN
Ph.D. in Chemical Engineering

PROFESSIONAL EXPERIENCE

1976 - 1982 US Navy
Nuclear Power Operator

- Served on USS Memphis (SSN-691)

1991 - 1994 3M Bioapplications Laboratory
Product Development Engineer

- Development and scale-up of biosupports for chromatography and biocatalysis

1994 - 2006 3M Occupational Health and Environ. Safety Laboratory
Maintenance-Free Respirator Laboratory Group Leader

- Development of filter media for respiratory protection
- Development of disposable respirators for global markets

2006 – February, 2009 3M Occupational Health and Environ. Safety Divisior
Six Sigma Black Belt

- Improvement of existing business and manufacturing processes in the 3M Occupational Health and Environ. Safety Division

February, 2009 – April, 2017 3M Personal Safety Division
Senior Product Development Specialist

- Development of disposable respirators for global markets

April, 2017 - present 3M Personal Safety Division
Division Scientist

- Development of disposable respirators for global markets
- Company-wide innovation

PATENTS AND PUBLICATIONS

Patents

US Patent 6,824,718 " Process of making a fibrous electret web"

US Patent 6,454,986 "Method of charging respirator filter fibrous web using a non-aqueous polar liquid"

US Patent 6,406,657 "Method of charging fibrous web with aqueous polar liquid"

US Patent 6,375,886 "Method of charging non-conductive free fibers"

US Patent 5,614,105 "Cartridge filters with insoluble enzyme particulates contained thereon"

US Patent 5,478,466 "New filter element for chemical conversions"

US Patent 5,468,847 "Method of isolating and purifying a biomacromolecule"

Publications

Johnson PR, Stern NJ, Eitzman PD, Rasmussen JK, Milbrath DS, Gleason RM and Hogancamp RE, "Reproducibility of physical characteristics, protein immobilization and chromatographic performance of 3M Emphaze Biosupport Medium AB1", Journal of Chromatography, 1994, vol 667, pp 1-9.

Eitzman PD and Srienc F, "Dynamics of activation of galactose-inducible promoter in Saccharomyces cerevisiae", Journal of Biotechnology, 1991, vol 21, pp 63-82.

Block DE, Eitzman PD, Wangensteen JD and Srienc F, "Slit scanning of Saccharomyces cerevisiae cells: Quantification of asymmetric cell division and cell cycle progression in asynchronous culture", Biotechnology Progress, 1990, vol 6, pp 504-512

Eitzman PD, Hendrick JL and Srienc F, "Quantitative immunofluorescence in single Saccharomyces cerevisiae cells", Cytometry, 1989, vol 10, pp 475-483.

Stainsby WN and Eitzman PD, "Roles of CO_2, O_2 and acid in arteriovenous $[H^+]$ during muscle contractions", Journal of Applied Physiology, 1988, vol 65, pp 1803-1810.

Stainsby WN, Sumners C and Eitzman PD, "Effects of adrenergic agonists and antagonists on muscle O_2 uptake and lactate metabolism", Journal of Applied Physiology, 1987, vol 62, pp 1845-1851.

Stainsby WN and Eitzman PD, "Lactic acid output of cat gastrocnemius-plantaris during repetitive twitch contractions", Medicine and Science in Sports and Exercize, 1986, vol 18, pp 668-673.

Stainsby WN, Sumners C and Eitzman PD, "Effects of catecholamines on lactic acid output during progressive working contractions", Journal of

Applied Physiology, 1985, vol 59, pp 1809-1814.

P. Eitzman(presenter), L. Barrett, J. Huberty, A. Viner, "A Comparison of 30 CFR 11 and 42 CFR 84 Certification Tests for Particulate Respirators." American Industrial Hygiene Conference and Exhibition, 1996, Washington, DC.

Presentations related to respiratory protection

Deposition and Trial Testimony of Philip D. Eitzman, Ph. D.

Testimony:	Expert/30(b)6	Date:	Case:
Deposition	Expert	8/12/2020	*Larry L. Roemmich and Gloria Roemmich, Husband and Wife* *Case No. 20-2-00926-1-KNT* *Superior Court of Washington, King Coun*
Deposition	Expert	1/23/2020	*Alfred M. Burton v. 3M Company, et al.* Case No. 19-2-17070-1-KNT Superior Court of Washington for King County
Deposition	30(b)6	1/9/2020	*Alfred M. Burton v. 3M Company, et al.* Case No. 19-2-17070-1-KNT Superior Court of Washington for King County
Deposition	30(b)6	5/30/2019	*Valerie Jean Culver as Personal Representative of the Estate of Robert D. Larson, Deceased and Bessie Jean Larson v. 3M Company, et al* Case No: 18-2-03806-5-SEA Superior Court of Washington for King County & *Wayne Wright, Individually and as Personal Representative for the Estate of Warren Wright, Deceased* Case No: 18-2-2204-5-SEA Superior Court of Washington for King County
Deposition	30(b)6	5/29/2019	*Valerie Jean Culver as Personal Representative of the Estate of Robert D. Larson, Deceased and Bessie Jean Larson v. 3M Company, et al* Case No: 18-2-03806-5-SEA Superior Court of Washington for King County & *Wayne Wright, Individually and as Personal Representative for the Estate of Warren Wright, Deceased* Case No: 18-2-2204-5-SEA Superior Court of Washington for King County
Deposition	Expert	4/29/2019	*Randolph Morton and Edna Morton v. 3M Company* Case No. 702643 Superior Court of the State of California, County of Los Angeles
Trial	Expert	4/11/2019	*Richard W. Lewis and Diane J. Lewis v. 3M Company, et al* Case 18-2-09747-4 Superior Court of Washington for Pierce County
Deposition	30(b)6	2/21/2019	*Richard W. Lewis and Diane J. Lewis v. 3M Company, et al* Case 18-2-09747-4 Superior Court of Washington for Pierce County
Deposition	Expert	2/12/2019	*Richard W. Lewis and Diane J. Lewis v. 3M Company, et al* Case 18-2-09747-4

Deposition and Trial Testimony of Philip D. Eitzman, Ph. D.

			Superior Court of Washington for Pierce County
Deposition	Expert	1/30/2019	*Terry Coleman, et al., v. 3M Company* *Case No. 16-CI-238* *David Allen, et al., v. 3M Company* *Case No. 16-CI-159* Knott County Circuit Court
Trial	Expert	12/12/2018	*Ida McCarthy, as Personal Representative* *of the Estate of Gerald T. McCarthy* Case No. 15-5621 Commonwealth of Massachusetts, Middlesex Superior Court
Deposition	Expert	10/31/2018	*Ida McCarthy, as Personal Representative* *of the Estate of Gerald T. McCarthy* Case No. 15-5621 Commonwealth of Massachusetts, Middlesex Superior Court
Deposition	30(b)6	5/23/2018	*Ida McCarthy, as Personal Representative* *of the Estate of Gerald T. McCarthy* Case No. 15-5621 Commonwealth of Massachusetts, Middlesex Superior Court
Trial	Expert	10/5/2018	*John Rothenbecker v. 3M Company* Case No. 3:17 – CV-585 United States District Court, Middle District Court of Pennsylvania
Deposition	Expert	6/12/2018	*David Allen, et al (Jerry Terry) v. 3M Company* Case No.16-CI-00159 Commonwealth of Kentucky, Knott Circuit Court
Deposition	30(b)6	5/23/2018	*Ida McCarthy, as Personal Representative* *of the Estate of Gerald T. McCarthy* Case No. 15-5621 Commonwealth of Massachusetts, Middlesex Superior Court
Trial	Expert	4/18/2018 and 4/20/2018	*Burnis Hall, et al (Leslie Cox and Michael Cox) v. 3M Company* *Case No. 16-CI-00100* *Commonwealth of Kentucky, Knott Circuit Court*
Deposition	Expert	2/16/2018	*Fred Williams v. 3M Company* *Case No. 16-CI-01061* *Commonwealth of Kentucky, Knott County*
Trial	Expert	2/1/2018	*Angel Rigor v. 3M Company* Case No. BC660976 Superior Court of the State of California, County of Los Angeles
Deposition	Expert	1/31/2018	*Angel Rigor v. 3M Company* Case No. BC660976

Deposition and Trial Testimony of Philip D. Eitzman, Ph. D.

			Superior Court of the State of California, County of Los Angeles
Deposition	Expert	1/9/2018	*Burnis Hall, et al (Leslie Cox and Michael Cox) v. 3M Company* *Case No. 16-CI-00100* *Commonwealth of Kentucky, Knott Circuit Court*
Deposition	30(b)6	12/13/2017	*Angel Rigor v. 3M Company* Case No. BC660976 Superior Court of the State of California, County of Los Angeles
Trial	Expert	9/15/2017 and 9/19/2017	*Isaac Overbee v. 3M Company* *Case No. 16-CI-00313* *County of Kentucky, Knott Circuit Court*
Deposition	30(b)6	6/22/2017	*Isaac Overbee v. 3M Company* *Case No. 16-CI-00313* *County of Kentucky, Knott Circuit Court*
Deposition	Expert	3/22/2017	*Shirley Broussard v. 3M Company* *Case: 1:16-CV-00462-SHE* *United States District Court* *Eastern District of California*
Deposition	Expert	2/13/2017	*Walter Readwin v. 3M Company, et al* *16-2-18894-0 SEA* *Superior Court of Washington County of King*
Deposition	30(b)6	1/25/2017	*Walter Readwin v. 3M Company, et al* *16-2-18894-0 SEA* *Superior Court of Washington County of King*
Deposition	Expert	9/14/2016	*Stanley McFadden v.3M Company* Case No. 4:14-CV-00803 United States District Court Eastern District of Missouri, Eastern Division
Trial	Expert	8/2016	*Fred Hill, et al. (Estate of Marion Russell Reynolds)* Case No. 05-C1-00589 Commonwealth of Kentucky, Perry Circuit Court
Deposition	Expert	7/19/2016	*Van Michael Parker v. 3M Company*

Deposition and Trial Testimony of Philip D. Eitzman, Ph. D.

			Case No. 15-369-NJR-PMF United States District Court, Southern District of Illinois
Deposition	Expert	6/29/2016	*Van Michael Parker v. 3M Company* *Case No. 15-369-NJR-PMF* *United States District Court, Southern District of Illinois*
Deposition	Expert	2/26/2016	*Elsa Clementir v. 3M Company, et al* *BC506479* *Los Angeles County*
Deposition	30(b)6	11/25/2015	*Edward Mozingo v. 3M Company, et al* *2013-69-CV6* *Jones County*
Trial	Expert	5/19/2015	*Jessie Gray v. 3M Company, et al* *13-PL-CC00036* *Pike County*
Deposition	Expert	2/24/2015	*Jessie Gray v. 3M Company, et al* *13-PL-CC00036* *Pike County*
Deposition	30(b)6	1/21/2015	*Gerald R. Boyd v. 3M Company, et a* RG-14-738647 Alameda County
Deposition	30(b)6	1/20/2015	*Gerald R. Boyd v. 3M Company, et al* RG-14-738647 Alameda County
Deposition	Expert	11/4/2014	*Fred Hill, et al v. 3M Company, et al* 05-CI-00589 Perry Circuit Court
Deposition	30(b)6	6/11/2014	*Jerry Clanton v. 3M Company, et al* 251-12-720-CIV Circuit Court of Hinds County

*Dr. Eitzman is an employee of 3M Company, there is no charge for his testimony.

Exhibit D

CURRICULUM VITAE (10/2017)

NAME: Thomas M. Wheeler, M.D.

WORK ADDRESS: Baylor College of Medicine
Department of Pathology & Immunology
One Baylor Plaza, Room T203
Houston, TX 77030
Phone: 713-798-4664
Fax: 713-798-6001
EMAIL: twheeler@bcm.tmc.edu

NATIONALITY: U.S.A.

EDUCATION:

1971-74	Houston Baptist University, Houston, Texas, B.S. Degree in Chemistry/Biology, Summa Cum Laude, awarded 1975
1974-77	Baylor College of Medicine, Houston, Texas, M.D. Degree with high honors 1977

POSTGRADUATE TRAINING:

1977-81	Resident in Pathology, Baylor College of Medicine and Affiliated Hospitals, Houston, Texas
1980-81	Chief Resident in Pathology, Baylor College of Medicine and Affiliated Hospitals, Houston, Texas

SPECIALTY BOARD CERTIFICATION:

1981	American Board of Pathology, Anatomic and Clinical
1990	American Board of Pathology, Cytopathology
1998, 2010	American Board of Pathology, Anatomic and Clinical, Voluntary Recertification.

LICENSURE:

1977	Texas (FLEX examination), E9007

FACULTY APPOINTMENTS:

1981-89	Assistant Professor of Pathology, Baylor College of Medicine, Houston, Texas
1987-89	Assistant Professor of Urology, Baylor College of Medicine, Houston, Texas
1989-91	Clinical Assistant Professor of Pathology, Baylor College of Medicine, Houston, Texas
1992-1995	Associate Professor of Pathology and Urology, Baylor College of Medicine, Houston, Texas

1995-pr	Professor of Pathology and Urology, Baylor College of Medicine, Houston, Texas
1995-pr	Associate Chairman for Clinical Affairs, Department of Pathology, Baylor College of Medicine, Houston, Texas
2001-pr	Harlan J. Spjut, M.D., Professor, Department of Pathology, Baylor College of Medicine, Houston, Texas
2004-2007	Interim Chairman, Department of Pathology, Baylor College of Medicine, Houston, Texas
2007-2009	Chairman, Department of Pathology, Baylor College of Medicine, Houston, Texas
2009-pr	Chairman, Department of Pathology & Immunology, Baylor College of Medicine, Houston, Texas
2013-pr	W.L. Moody, Jr., Professor & Chair , Department of Pathology & Immunology, Baylor College of Medicine, Houston, TX

HONORS & AWARDS:

College:
Alpha Chi Honor Society
American Institute of Chemists Award (outstanding senior student in Chemistry)
Outstanding Alumnus, Houston Baptist University, 1997

Medical School and Postgraduate Career:
Alpha Omega Alpha, 1976--present
Stuart A. Wallace Award (outstanding student in Pathology), 1976
Award for Excellence in Physiology, 1975
Voted by peers to be included in listing of *The Best Doctors in America*, 1998-present
Herbert Lansky Award, College of American Pathologists, 1999
Life Member of the *National Registry of Who's Who*, 2001
Voted by peers to be included in listing of *America's Top Doctors*, 2001-present
George T. Caldwell, MD Distinguished Service Award, Texas Society of Pathologists, 2007
Outstanding Alumnus, Baylor College of Medicine, 2009
Voted by peers to be included in listing of *America's Top Doctors for Cancer*, 2007-present
Harlan J. Spjut Award, presented by Houston Society of Clinical Pathologists, 2012
Meritorious Patient Service Award, presented by the College of American Pathologists, 2014

TEXAS MEDICAL CENTER HOSPITAL STAFF POSITIONS:

2016 – present	Chief of Pathology Service and Laboratory Director CHI/Baylor St. Luke's Medical Center
1981-present	Attending Pathologist, Ben Taub General Hospital, Chief of Pathology 2013-2015
1991-2004	Deputy Chief of Service, Department of Pathology, Houston Methodist Hospital, Houston, Texas
1989-91	Attending Pathologist, Memorial Hospital System, Houston, Texas

1985-89	Attending Pathologist and Head, Section of Anatomic Pathology, Houston Methodist Hospital, Houston, Texas
1981-1985	Assistant Pathologist, Section of Anatomic Pathology, Houston Methodist Hospital, Houston, Texas

TEXAS MEDICAL CENTER EDUCATIONAL ACTIVITIES:

1981-pr	Lecturer in sophomore Pathology Course, Baylor College of Medicine, Houston, Texas
1985-86	Lecturer in Cytotechnology School of the University of Texas School for Allied Health Sciences, Houston, Texas

EDITORIAL BOARD:

1996-pr	*Human Pathology*
1999-pr	*Prostate*
1999-01	*Clinical Thyroidology*
2000-pr	*American Journal of Surgical Pathology*
2005-pr	*Archives of Pathology & Laboratory Medicine* (Executive Advisory Board)
2007-pr	Editor-in-Chief, *Medscape Reference* online textbook of Pathology and Laboratory Medicine
2010-pr	*American Journal of Translational Research*
2010-pr	Medscape for WebMD Pathology & Laboratory Medicine Advisory Board
2010-pr	Modern Pathology

Ad hoc reviewer:

Cancer
Journal of Urology
British Journal of Urology
Urology
Cancer Research
Journal of Clinical Oncology
Clinical Cancer Research
American Journal of Pathology
New England Journal of Medicine
Canadian Journal of Urology

MEDICAL ADVISORY BOARD:

August 2017 – present Board Member, Insightec

PROFESSIONAL SOCIETY MEMBERSHIPS:

Alpha Omega Alpha
American Board of Pathology, Anatomic Pathology Test Committee (1995-99)
American Association for Cancer Research
American Foundation for Thyroid Patients (Medical Advisory Board, 1998-1999)
American Medical Association
American Society for Clinical Pathology
American Society of Cytopathology
American Society of Investigative Pathology
American Thyroid Association
American Urological Association

Association of Pathology Chairs
College of American Pathologists (State Advisory Committee, 1994-97 Chair, 1999-2000; Delegate to House of Delegates, 1993-2003; Government Affairs Committee, 1996-2003, Chair 2001; Council on Government and Professional Affairs, 1999-2003, 2010-2016; Nominating Committee 2000 and 2010-11, Chair, 2001, 2011; Education Committee 2004-2006; Council on Scientific Affairs, 2004-2010, 2012-pr, Chair, 2005-2009; Board of Governors, 2003-2009; Compensation Committee, 2005; Executive Committee, 2005-2009, Chair, Ad Hoc Work Group for Pathology Report Standardization, 2006-07, Cancer Protocol Panel on Genitourinary Tumors, 2007-pr, Joint CAP/ASCO ad hoc joint committee on HER2, ER/PR testing. Cancer Committee 2010-2011, Education Program AP3, GU Prostate (Chair) 2011-pr; Policy Roundtable Committee 2012-pr; Practice Characteristics Survey Subcommittee, Chair 2015; Liaison: International Collaboration on Cancer Reporting (ICCR) Board of Directors
Harris County Medical Society
Houston Society of Clinical Pathologists (President, 1992; Scientific Seminar Chair 1988, 2001)
International Society of Urological Pathology
Society of Cardiovascular Pathology
Texas Society of Cytology (President, 1988)
Texas Society of Pathologists (Alternate Delegate, 1993-1995, Delegate 1995-present, Secretary 1997, President-Elect 1998, President 1999, Chair Nominating Committee 2000); member, Legislative Council, 2005-present
The Thyroid Society for Education and Research (Board of Directors, 1993-98)
U.S. and Canadian Academy of Pathology (Abstract Review Board, 1997-2000, 2006-2009)
Center for Medicine after the Holocaust (Board of Directors 2010-2016)

COMMITTEES:

1984-04	HMH Cancer Committee (Chairman; 1992-95; 1998-2004)
	HMH Tumor Registry Subcommittee (Chairman, 1986-89)
1986-88	HMH Record Committee
1994-98	HMH Operating Room Committee
1996-04	HMH General Abdominal Pelvic Quality Management Committee (Chair 2004)
2000-01	HMH Nominating Committee (Chairman 2000)
2000-03	Baylor Medcare Executive Committee
2000-05	Baylor Medical Liability Insurance Committee
2003-05	Texas State Board of Medical Examiners Expert Physician Panel Member
2005-pr	Love Award Selection Committee, BCM
2006-08	Cancer Committee, Medical Staff Committee, St. Luke’s Episcopal Hospital
2004-pr	Faculty Appointments and Promotions Committee, BCM (Deputy Vice Chair, 2010-2015; Chairman 2015 - present)
2004-pr	Academic Council, BCM
2011-pr	Faculty Group Practice Executive Committee, BCM
2013-14	Business Development Committee, BCM
2014-pr	COI Committee BCM
2016-pr	Baylor St. Luke’s Medical Center: Medical Executive Cmt; Credentials Cmt

GRANTS:

1992-2007	Director, CF2, Pathology, Specialized Program Of Research Excellence (SPORE) in Prostate Cancer, National Institute of Health, 1 P50 CA58204- 01 CF2, Direct Costs: $115,939

1992-2007 SPORE in Prostate Cancer (PI: Thompson, Timothy), Project Number: 5 P50 CA05204-10, Source: NIH/NCI, Direct Cost: $131,959.

1999-2004 Transgenic Mouse Models of Prostate Cancer (PI: Norman Greenberg), Project Number: 5 U01 CA84296-05 PJ2, Direct Cost: $41,313.

1994-2009 Director of Central Histopathology Reading Center, Prostate cancer Intervention Versus Observation Trial (PIVOT), Veterans Administration/National Cancer Institute Cooperative Studies Program #CSP 407

1995-2005 Principal Investigator, Pathology, Cooperative Human Tissue Network, National Institute of Health, U01 CA44968, Direct Costs: $13,344

1997-2002 Co-Investigator, RP1, Pathology, National Institute of Health, P50 CA58204-RP1, Direct Costs: $98,600

1999-2001 Principal Investigator, Administrative Supplement, Pathology, National Institute of Health, P50 CA58204, Direct Costs: $271,425

2001 PIN 1 Evaluation in Prostate Cancer, Project Number: Pintex Pharmaceuticals, Source: Pintex Pharm., Inc., Direct Cost: $126,984.

2003-2006 MR Imaging and MR Spectroscopic Imaging of Prostate Cancer Prior to Radical Prostatectomy: A Prospective Multi-Institutional Clinicopathological Study (Pathologist Central Reviewer). ACRIN 6659. Direct Cost $$24,000

2005-2009 Principal Investigator, "A Randomized Double-Blind, Placebo-Controlled, Parallel Group Study of the Efficacy and Safety of Dutasteride 0.5mg Administered Orally Once Daily for Four Years to Reduce the Risk of Biopsy-Detectable Prostate Cancer". GlaxoSmithKline. Direct Costs: $29,600

INVENTIONS, PATENTS AND COPYRIGHTS:

"Prostate Tissues (Frozen) For Research"
Developers: **Thomas M. Wheeler**
Licensee: Epigenomics, Inc.

"A Nomogram to Predict the Risk of Any Cancer and of Clinically Significant Cancer Detection at Prostate Biopsy Utilizing Clinical Parameters and Novel Serum Markers (e.g. including hK2, proPSA, BPSA)"

Filed with United States Patent and Trademark Office: May 11, 2005
Developers: Kevin M. Slawin, Michael W. Kattan, **Thomas M. Wheeler**
Licensee: Progression Therapeutics, Inc.

PUBLICATIONS:

Papers:

1. **Wheeler T**, McGavran M, Sessions R: Myospherulosis, iatrogenic nasal and paranasal entity. *Arch Otolaryngol* 106:272, 1980.

2. **Wheeler T**, McGavran M. Myospherulosis, further observations. *Am J Clin Pathol* 73:685, 1980.

3. Panko W, Mattioli C, **Wheeler T**. Lack of correlation of a histochemical method for estrogen receptor analysis with the biochemical assay results. *Cancer* 49:2149, 1982.

4. Rice L, Laughter A, Twomey J, Abramson S, **Wheeler T**, Shanken P. Angioimmunoblastic lymphadenopathy with hypogammaglobulinemia: possible role of monocyte suppression. *Am J Med* 72:998, 1982.

5. Rice L, Shenkenberg T, Lynch E, **Wheeler T**: Granulomatous infections complicating hairy cell leukemia. *Cancer* 49:1924, 1982.

6. Rubenfeld S, **Wheeler T**, Spjut H. Fine needle aspiration of thyroid nodules. *Texas Med* 78:41, 1982.

7. Font R, **Wheeler T**, Boniuk M. Intravascular papillary endothelial hyperplasia of the orbit and ocular adnexa: report of 5 cases. *Arch Ophthalmol* 101:1731, 1983.

8. Riccardi V, **Wheeler T**, Pickard L, King B. The pathophysiology of neurofibromatosis: II. Angiosarcoma as a complication. *Cancer Genet Cytogenet* 12:275, 1984.

9. Scardino P, **Wheeler T**: Prostatic biopsy after irradiation therapy for prostatic cancer. *Suppl Urol* 5:39, 1985.

10. Rex J, Harris R, **Wheeler T**, *et al.*: Granulomatous disease complicating hairy cell leukemia. *Texas Med* 81:31, 1985.

11. Harris R, Lawrie G, **Wheeler T**, *et al.*: Successful management of Histoplasma capsulatum infection of an abdominal aortic aneurysm. *J Vasc Surg* 3:649-651, 1986.

12. Scardino P, Frankel J, **Wheeler T**, *et al.*: The prognostic significance of post-irradiation biopsy results in patients with prostatic cancer. *J Urol* 135:510, 1986.

13. Irani D, **Wheeler T**: Tyrosine crystals in a pleomorphic adenoma. *The American Society of Clinical Pathologists Check Sample, Cytopathology* 10(5), 1986.

14. Truong L, Harris L, Mattioli C, Hawkins E, Lee A, **Wheeler T**, Lane M: Endodermal sinus tumor of the mediastinum. *Cancer* 58:730, 1986.

15. Coburn M, **Wheeler T**, Lipshultz L: Testicular biopsy: uses and limitations. *Urol Clin N Am* 14:551, 1987.

16. **Wheeler T**, Zimmerman T. Expulsive choroidal hemorrhage in the glaucoma patient. *Ann Ophthalmol.* 19: 165-6, 1987.

17. Goldfarb R, Pool J, **Wheeler T.** Isolated renal artery dissection secondary to medial degeneration. *J Urol* 139:346, 1988.

18. **Wheeler T**, Johnson E, Coughlin D, Greenberg S. The sensitivity of detection of asbestos bodies in sputa and bronchial washings. *Acta Cytologica* 32:647, 1988.

19. Neerhut G, **Wheeler T**, Cantini M., Scardino P. Salvage radical prostatectomy for radiorecurrent adenocarcinoma of the prostate. *J Urol* 140:544, 1988.

20. Scardino P, **Wheeler T**: Local control of prostate cancer with radiotherapy: the frequency and prognostic significance of positive post-irradiation prostate biopsy results. *Nat Cancer Inst Monogr* 7:95-103, 1988.

21. Meacham R, Mata J, Espada R, **Wheeler T**, Schum C, Scardino P: Testicular metastasis as the first manifestation of colon carcinoma. *J Urol* 140:621, 1988.

22. Rubenfeld S, **Wheeler T**: Thyroid cancer presenting as a hot thyroid nodule: report of a case and review of the literature. *Clin Exp Thyroidol* 1:41, 1988.

23. Truong L, Ansari M, Ansari S, **Wheeler T**, *et al.*: Acquired cystic kidney disease: occurrence in patients on chronic peritoneal dialysis. *Am J Kid Dis* 11:192, 1988.

24. Egawa S, Carter S, **Wheeler T**, Scardino P: Significance of hypoechoic lesions in the irradiated prostate. *J Endourol* 3:147, 1989.

25. Donovan DT, Levy ML, Furst EJ, Alford BR, **Wheeler T**, Tschen JA, Gagel RF. Familial Cutaneous Lichen Amyloidosis in Association With Multiple Endocrine Neoplasia Type 2A: A New Variant. *Henry Ford Hosp Med J*. 1989;37(3-4):147-50.

26. Shinohara K, **Wheeler T**, Scardino P: The appearance of prostate cancer on transrectal ultrasonography: Correlation of imaging and pathological examination. *J Urol* 142:76, 1989.

27. **Wheeler T**: Anatomical considerations in carcinoma of the prostate. *Urol Clin N Am* 16:623, 1989.

28. Scardino P, Shinohara K, **Wheeler T**, Carter S: Staging of prostate cancer, value of ultrasonography. *Urol Clin N Am* 16:713, 1989.

29. Egawa S, Carter S, **Wheeler T**, Scardino P: Ultrasonographic changes in the normal and malignant prostate after definitive radiotherapy. *Urol Clin N Am* 16:741, 1989.

30. Shinohara K, Scardino P, Carter S, **Wheeler T**: The pathologic basis of the sonographic appearance of the normal and malignant prostate. *Urol Clin N Am* 16:674-691, 1989.

31. Gagel R, Levy M, Donovan D, Alford B, **Wheeler T**, Tschen J: Multiple endocrine neoplasia type 2a associated with cutaneous lichen amyloidosis. *Ann Int Med* 111:802-806, 1989.

32. Truong L, Mody D, Cagle P, Jackson-York G, Schwartz M, **Wheeler T**: Thymic carcinoma: a clinicopathologic study of 13 cases. *Am J Surg Pathol* 14(2):151-166, 1990.

33. Greene D, Egawa S, Neerhut G, Flanagan W, Dunn J, **Wheeler T**, Scardino P: The distribution of residual cancer in radical prostatectomy specimens in stage A prostate cancer. *J Urol* 145:324-329, 1991.

34. Egawa S, Greene D, **Wheeler T**, Scardino P: The sonographic appearance of irradiated prostate cancer. *Br J Urol* 68:172-177, 1991.

35. Egawa S, Greene D, Flanagan W, **Wheeler T**, Scardino P: Transrectal ultrasonography in stage A prostate cancer: detection of residual tumor after transurethral resection of the prostate. *J Urol* 146:366-371, 1991.

36. Greene D, **Wheeler T**, Egawa S, Dunn J, Scardino P: A comparison of the morphological features of cancer arising in the transition zone and in the peripheral zone of the prostate. *J Urol* 146:1069-1076, 1991.

37. Greene D, Taylor S, **Wheeler T**, Scardino P: DNA ploidy by image analysis of individual foci of prostate cancer: a preliminary report. *Cancer Res* 51:4084-4089, 1991.

38. Greene D, **Wheeler T**, Egawa S, Weaver R, Scardino P: The relationship between clinical stage and histological zone of origin in early stage prostate cancer: a morphometric analysis. *Br J Urol* 68:499-509, 1991.

39. Egawa S, **Wheeler T**, Greene D, Scardino P: The detection of residual prostate cancer after radiotherapy by sonographically-guided needle biopsy. *Urology* 39: 358-363, 1992.

40. Egawa S, Greene D, **Wheeler T**, Scardino P: Unusual hyperechoic appearance of prostate cancer on transrectal ultrasonography. *Br J Urol* 69:169-174, 1992.

41. Egawa S, Carter S, **Wheeler T**, Scardino P: Sonographic monitoring of prostatic cancer after definitive radiotherapy. *Urology* 40:230, 1992.

42. Rosen M, Lapin S, Goldstone L, **Wheeler T**, Scardino P: Frequency and location of extracapsular extension and positive surgical margins in radical prostatectomy specimens. *J Urol* 148:331, 1992.

43. Bostwick D, Montironi R, Nagle R, Pretlow T, Miller G, **Wheeler T**: Current and proposed biologic markers in prostate cancer. *J Cell Biochem Suppl* 16H:65-67, 1992.

44. Ohori M, Scardino P, Lapin S, Seale-Hawkins C, Link J, **Wheeler T**: The mechanisms and prognostic significance of seminal vesicle involvement by prostate cancer. *Am J Surg Pathol* 17(12):1252-1261, 1993.

45. Ohori M, Shinohara K, **Wheeler T**, Aihara M, Wessels E, Carter S, Scardino P: Ultrasonographic detection of non-palpable seminal vesicle invasion: A clinicopathological study. *Br J Urol* 72:799-808, 1993.

46. Scardino P, Rogers E, Aihara M, Sariyuce O, **Wheeler T**: TURP for BPH: declining incidence and changing nature of incidental (stage A) prostate cancer (A summary of the presentation by E. Rogers at the South Central Section of the AUA). *Urology Times* 21:10, 1993.

47. Ohori M, **Wheeler T**, Greene D, Scardino P: Comparison of the pathologic features and DNA ploidy value of prostate cancers detectable by sonography and by palpation. *The Prostate* 23:10, 1993.

48. Greene D, Rogers E, Wessels E, **Wheeler T**, Taylor S, Santucci R, Thompson T, Scardino P: Some small prostate cancers are nondiploid by nuclear image analysis: correlation of deoxyribonucleic acid ploidy status and pathological features. *J Urol* 151:1301-1307, 1994.

49. Ostrowski M, **Wheeler T**: Paraganglia of the prostate: location, frequency, and differentiation from prostatic adenocarcinoma. *Am J Surg Pathol* 18:412-420, 1994.

50. Aihara M, Lebovitz R, **Wheeler T**, Kinner B, Ohori M, Scardino P: Prostate specific antigen and Gleason grade: an immunohistochemical study of prostate cancer. *J Urol* 151:1558-1564, 1994.

51. Aihara M, Ohori M, Wessels E, **Wheeler T**, Scardino P: Heterogeneity of prostate cancer in radical prostatectomy specimens. *Urology* 43:60-67, 1994.

52. Truong L, Ostrowski M, **Wheeler T**: Tamm-Horsfall protein in bladder tissue: morphologic spectrum and clinical significance. *Am J Surg Pathol* 18:615-622, 1994.

53. Ohori M, **Wheeler T**, Scardino P: The New American Joint Committee on Cancer and International Union Against Cancer TMN Classification of Prostate Cancer: clinicopathologic correlations. *Cancer* 74:104-114, 1994.

54. Greene D, **Wheeler T**: Clinical relevance of the individual prostate cancer focus. *Cancer* Invest 12(4):425-437, 1994.

55. Ohori M, Egawa S, Shinohara K, **Wheeler T**, Scardino P: Detection of microscopic extracapsular extension prior to radical prostatectomy for clinically localized prostate cancer. *Br J Urol* 74:72-79, 1994.

56. **Wheeler T**, Rogers E, Aihara M, Scardino P, Thompson T: Apoptotic index as a biomarker in prostatic intraepithelial neoplasia (PIN) and prostate cancer. *J Cell Biochem* 19:202-207, 1994.

57. Pindur A, Chakraborty S, Welch D, **Wheeler T**: DNA ploidy measurements in prostate cancer: differences between image analysis and flow cytometry and clinical implications. *The Prostate* 25:189-198, 1994.

58. Ohori M, Egawa S, **Wheeler T**: Nodules resembling nodular hyperplasia in the peripheral zone of the prostate gland. *J Urologic Pathol* 2:223-233, 1994.

59. Ohori M, **Wheeler T**, Dunn J, Stamey T, Scardino P: The pathologic features and prognosis of prostate cancer detectable with current diagnostic tests. *J Urol* 152:1714-1720, 1994.

60. Ohori M, Goad J, **Wheeler T**, Eastham J, Thompson T, Scardino P: Can radical prostatectomy alter the progression of poorly differentiated prostate cancer? *J Urol* 152:1843-1849, 1994.

61. **Wheeler T**, Lebovitz R: Fresh tissue harvest for research from prostatectomy specimens. *The Prostate* 25:274-279, 1994.

62. Aihara M, Truong L, Dunn J, **Wheeler T**, Scardino P, Thompson T: Frequency of apoptotic bodies positively correlates with Gleason grade in prostate cancer. *Human Pathol* 25:797-801, 1994.

63. Norberg M, Holmberg L, **Wheeler T**, Magnusson A: Five year follow-up after radical prostatectomy for localized prostate cancer – a study of the impact of different tumor variables on progression. *Scan J Urol Nephrol* 28:391-399, 1994.

64. Bostwick D, Burke H, **Wheeler T**, Chung L, Bookstein R, Pretlow T, Nagle R, Montironi R, Lieber M, Veltri R, Grizzle W, Grignon D: The most promising surrogate endpoint biomarkers for screening candidate chemopreventative compounds for prostatic adenocarcinoma in short-term phase II clinical trials. *J Cell Biochem* 19(Suppl):283-289, 1994.

65. Gagucas R, Brown R, **Wheeler T**: Verumontanum mucosal gland hyperplasia. *Am J Surg Pathol* 19:30-36, 1995.

66. Rogers E, Ohori M, Kassabian S, **Wheeler T**, Scardino P: Salvage radical prostatectomy: outcome measured by serum prostate specific antigen levels. *J Urol* 153:104-110, 1995.

67. Aihara M, Scardino P, Truong L, **Wheeler T**, Goad J, Yang G, Thompson T: The frequency of apoptosis correlates with the prognosis of Gleason grade 3 adenocarcinoma of the prostate. *Cancer* 75:522-529, 1995.

68. Aihara M, **Wheeler T**, Ohori M, Scardino P: Eterogeneita del carcinoma della prostata in campioni da prostatectomia radicale. *Urol Digest* 1995.

69. Ostrowski M, Brown R, **Wheeler T**, Green L, Schaffner D: Leu-7 immunoreactivity in cytologic specimens of thyroid lesions, with emphasis on follicular neoplasms. *Diag Cytopathol* 12:297-302, 1995.

70. Epstein J, Grignon D, Humphrey P, McNeal J, Sesterhenn I, Troncoso P, **Wheeler T**: Interobserver reproducibility in the diagnosis of prostatic intraepithelial neoplasia. *Am J Surg Pathol* 19:873-886, 1995.

71. Bjornsson B, Truong L, Cartwright J, Abrams J, Rutledge M, **Wheeler T**: Pelvic lymph node histiocytosis mimicking metastatic prostatic adenocarcinoma: association with hip prostheses. *J Urol* 154:470-473, 1995.

72. Ohori M, **Wheeler T**, Kattan M, Goto Y, Scardino P: Prognostic significance of positive surgical margins in radical prostatectomy specimens. *J Urol* 154:1818-1824, 1995.

73. Eastham J, Stapleton A Gousse A, Timme T, Yang G, Slawin K, **Wheeler T**, Scardino P, Thompson T: Association of p53 mutations with metastatic prostate cancer. *Clin Cancer* Res 1:1111-1118, 1995.

74. Gilcrease M, Schmidt L, Zbar B, Truong L, Rutledge M, **Wheeler T**: Somatic von Hippel-Lindau mutation in clear cell papillary cystadenoma of the epididymis. *Hum Pathol* 26:1341-1346, 1995.

75. Leibman B, Dillioglugil O, **Wheeler T**, Scardino P: Distant metastasis after radical prostatectomy in patients without an elevated serum prostate specific antigen level. *Cancer* 76:2530-2534, 1995.

76. Gaudin P, **Wheeler T**, Epstein J: Verumontanum mucosal gland hyperplasia in prostatic needle biopsy specimens: a mimic of low grade prostatic adenocarcinoma. *Am J Clin Pathol* 104:620-626, 1995.

77. Arakawa A, Song S, Scardino P, **Wheeler T**: High grade prostatic intraepithelial neoplasia in prostates removed following irradiation failure in the treatment of prostatic adenocarcinoma. *Path Res Pract* 191:868-872, 1995.

78. Rogers E, Eastham J, Ohori M, Sariyuce O, Aihara M, **Wheeler T**, Scardino P: Impalpable prostate cancer: clinicopathologic features. *Br J Urol* 77:429-432, 1996.

79. Yang G, Stapleton A, **Wheeler T**, Truong L, Timme T, Scardino, Thompson T: Clustered p53 immunostaining: a novel pattern associated with prostate cancer progression. *Clin Cancer Res* 2:399-401, 1996.

80. Bostwick D, **Wheeler T**, Blute M, Barrett D, MacLennan G, Sebo T, Scardino P, Humphrey P, Hudson M, Fradet Y, Miller G, Crawford E, Blumenstein B, Mahran H, Miles B: Optimized microvessel density analysis improves prediction of cancer stage from prostate needle biopsies. *Urology* 48(1):47-57, 1996.

81. **Wheeler T**: The influence of irradiation and androgen ablation on prostatic intraepithelial neoplasia. *European Urol* 30:261-264, 1996.

82. Sakr W, **Wheeler T**, Blute M, Bodo M, Calle-Rodrigue R, Henson D, Mostofi F, Seiffert J, Wojno K, Zincke H: Workgroup 2: staging and reporting of prostate cancer – sampling of the radical prostatectomy specimen. *Cancer* 78/2:366-368, 1996.

83. Goto Y, Ohori M, Arakawa A, Kattan M, **Wheeler T**, Scardino P: Distinguishing clinically important from unimportant prostate cancers before treatment: value of systematic biopsies. *J Urol* 156:1059-1063, 1996.

84. Yang G, **Wheeler T**, Kattan M, Scardino P, Thompson T: Perineural invasion of prostate carcinoma cells is associated with reduced apoptotic index. *Cancer* 78(6):1267-1271, 1996.

85. Williams R, Stapleton A, Yang G., Truong L, Rogers E, Timme T, **Wheeler T**, Scardino P, Thompson T: Reduced levels of transforming growth factor β receptor type II in human prostate cancer: an immunohistochemical study. *Clin Cancer Res* 2:635-640, 1996.

86. Sutton M, Berkman S, Chen S, Block A, Dang T, Kattan M, **Wheeler T**, Rowley D, Woo S, Lerner S: Adenovirus-mediated suicide gene therapy for experimental bladder cancer. *Urology* 49:173-180, 1997.

87. Kattan M, Stapleton A, **Wheeler T**, Scardino P: Evaluation of a nomogram for predicting pathological stage of men with clinically localized prostate cancer. *Cancer* 79(3):528-537, 1997.

88. Arakawa A, Soh S, Chakraborty S, Scardino P, **Wheeler T**: Prognostic significance of angiogenesis in clinically localized prostate cancer (staining for factor VIII-related antigen and CD34 antigen). *Prostate Cancer and Prostate Diseases* 1: 32-38, 1997.

89. Light J, Ripoll E, **Wheeler TM**: The striated urethral sphincter: muscle fibre types and distribution in the prostatic capsule. *Br J Urol* 79:539-542,1997.

90. Soh S, Kattan M, Berkman S, **Wheeler T**, Scardino P: Has there been a recent shift in the pathological features and prognosis of patients treated with radical prostatectomy? *J Urol*. 157:2212-2218, 1997.

91. Arakawa A, Soh S, **Wheeler T**: High-grade prostatic intraepithelial neoplasia in cystoprostatectomy specimens. *J Urologic Pathol* 7(1):1-8, 1997.

92. Elbadawi A, Mathews R, Light J, **Wheeler T**: Immunohistochemical and ultrastructural study of rhabdosphincter component of the prostatic capsule. *J Urol* 158:1819-1828, 1997.

93. Dillioglugil O, Leibman B, Kattan M, Seale-Hawkins C, **Wheeler T**, Scardino P: Hazard rates for progression after radical prostatectomy for clinically localized prostate cancer. *Urology* 50:93-99, 1997.

94. Lin W, Lamb D, **Wheeler T**, Abrams J, Lipshultz L, Kim E. Apoptotic frequency is increased in spermatogenic maturation arrest and hypospermatogenic states. *J Urol*. 158:1791-3,1997.

95. Stapleton A, Timme T, Gousse A, Li Q-F, Tobon A, Kattan M, Slawin K, **Wheeler T**, Scardino P, Thompson T: Primary human prostate cancer cells harboring p53 mutations are clonally expanded in metastases. *Clin Cancer Res* 3:1389-1397, 1997.

96. Lin W, Lamb D, **Wheeler T**, Lipshultz L, Kim E: In situ end-labeling of human testicular tissue demonstrates increased apoptosis in condition of abnormal spermatogenesis. *Fertil Steril* 158:1791-3, 1997.

97. Woods J, Soh S, **Wheeler T**: Distribution and significance of microcalcifications in the neoplastic and non-neoplastic prostate. *Arch Pathol Lab Med* 122:152-155, 1998.

98. Scardino P, Thompson T, Stapleton A, Zbell P, Kattan M, Yang G, **Wheeler T**: Assessment of the biological markers p53, Ki-67, apoptotic index as predictive indicators of prostate cancer recurrence following surgery. *Cancer* 82:168-175, 1998.

99. Ren C, Yang G, Timme T, **Wheeler T**, Thompson T: Reduced lysyl oxidase messenger RNA levels in experimental and human prostate cancer. *Cancer Research* 58:1285-1290, 1998.

100. Anton R, Chakraborty S, **Wheeler T**: The significance of intraluminal prostatic crystalloids in benign needle biopsies. *Am J Surg Pathol* 22(4):446-449, 1998.

101. Hampel O, Kattan M, Yang G, Haidacher S, Saleh G, Thompson T, **Wheeler T**, Marcelli M: Quantitative immunohistochemical analysis of insulin-like growth factor binding protein-3 in human prostatic adenocarcinoma: A Prognostic Study. *J Urol* 159:1-6, 1998.

102. Kattan M, Eastham J, Stapleton A, **Wheeler T**, Scardino P: A preoperative nomogram for disease recurrence following radical prostatectomy for prostate cancer. *J Natl Cancer Inst* 90(10):766-771, 1998.

103. Adler H, Haddad J, **Wheeler T,** Kim E: Intratesticular adenomatoid tumor radiographically mimicking a primary testicular neoplasm. Digital *J Urol,* http://www.duj.com, 1998.

104. Lin W, Lamb D, **Wheeler T**, Lipshultz L, Kim E: Absence of cyclic adenosine 3':5' monophosphate responsive element modulator expression at the spermatocyte arrest stage. *Fertil. Steril*., 69: 533-538, 1998.

105. **Wheeler T**: Prediction of pathologic stage and patient outcome from biopsy findings. *J Urologic Pathol* 8:45-53, 1998.

106. Erdamar S, Slawin K, **Wheeler T**: High-grade prostatic intraepithelial neoplasia involving the Prostatic utricle. *J Urologic Pathol* 8(3):167-170, 1998.

107. Yang G, Truong L, Timme T, Ren C, **Wheeler T**, Park S, Nasu Y, Bangma C, Kattan M, Scardino P, Thompson T: Elevated expression of caveolin is associated with prostate and breast cancer. *Clinical Cancer Research* 4:1873-1880, 1998.

108. **Wheeler T**, Dillioglugil O, Kattan M, Arakawa A, Soh S, Suyama K, Ohori M, Scardino P: Clinical and pathological significance of the level and extent of capsular invasion in clinical stage T1-2 prostate cancer. *Human Pathol* 29(8):856-862, 1998.

109. Peterson L, Zhumadilov Z, Kripalani S, Prouglo Y, **Wheeler T**, Gusev B, Arem R, Yonov S, Weinberg A: Diagnosis of benign and malignant thyroid disease in the East Kazakhstan Region of Kazakhstan: a case review of pathological findings of 2525 patients. *Cancer Research Therapy and Control* 5(4):307-312, 1998.

110. Wilcox G, Soh S, Chakraborty S, Scardino P, **Wheeler T**: Patterns of high-grade prostatic intraepithelial neoplasia associated with clinically aggressive prostatic cancer. *Human Pathol* 29:1119-1123, 1998.

111. Hu J, Palapattu G, Kattan M, Scardino P, **Wheeler T**: The Association of selected pathological features with prostate cancer in a single needle biopsy accession. *Human Pathol* 29:1536-1538, 1998.

112. Kattan M, Eastham J, Stapleton A, **Wheeler T**, Scardino P: A preoperative nomogram for disease recurrence following radical prostatectomy for prostate cancer. *J Natl Ca Inst* 90: 766-771, 1998.

113. Stapleton A, Zbell P, Kattan M, Yang G, **Wheeler T**, Scardino P, Thompson T. Assessment of the biological markers p53, Ki-67, apoptotic index as predictive indicators of prostate cancer recurrence following surgery. *Cancer* 82:168-175, 1998.

114. Kim E, Scardino P, Hampel O, Mills N, **Wheeler T**, Nath R: Interposition of sural nerve restores functions of cavernous nerves resected during radical prostatectomy. *J Urol* 161: 188-192, 1999.

115. Krouskop T, **Wheeler T**, Kallel F, Garra B, Hall T: Elastic Moduli of Breast and Prostate Tissues Under Compression. *Ultrasonic Imaging* 20:260-274, 1998.

116. Kattan M, **Wheeler T**, Scardino P. A postoperative nomogram for disease recurrence following radical prostatectomy for prostate cancer. *J Clin Oncol* 17: 1499-1507, 1999.

117. Anton R, Kattan M, **Wheeler T**: Postatrophic hyperplasia of the prostate: lack of association with prostate cancer. *Am J Surg Pathol*, 23: 932-36, 1999.

118. Erdamar S, Yang G, Harper J, Xin L, Kattan M, Thompson T, **Wheeler T**: Levels of expression of p27 protein in human prostate and prostate cancer: an immunohistochemical analysis. *Modern Pathology* 12:751-55, 1999.

119. Yang G, Truong L, **Wheeler T**, and Thompson T. Caveolin-1 Expression in Clinically Confined Human Prostate Cancer: A Novel Prognostic Marker, *Cancer Research*, 59: 5719-5723, 1999.

120. Mikolajczyk S, Millar L, Wang T, Rittenhouse H, Marks L, Song W, **Wheeler T**, and Slawin K: A Precursor Form of Prostate-specific Antigen is More Highly Elevated in Prostate Cancer Compared with Benign Transition Zone Prostate Tissue. *Cancer Research*, 60: 756-759, 2000.

121. Mikolajczyk S, Millar L, Wang T, Rittenhouse H, Wolfert R, Marks L, Song W, **Wheeler T,** Slawin K: "BPSA," A Specific Molecular Form of Free Prostate-Specific Antigen, is Found Predominantly in the Transition Zone of Patients with Nodular Benign Prostatic Hyperplasia, *Urology*, 55: 41-45, 2000.

122. Tokunaga H, Lee D-H, Kim I, **Wheeler T**, Lerner S: Decreased expression of transforming growth factor-beta receptor Type I is associated with poor prognosis in bladder transitional cell carcinoma patients. *Clin Caner Res*, 5: 2520-2525, 1999.

123. Ohori M, Abbas F, **Wheeler T**, Kattan M, Scardino P, Lerner S: Pathological features and prognostic significance of prostate cancer I the apical section as determined by whole mount histology. *J. Urol*, 161: 500-504, 1999.

124. Herman J, Adler H, Aguilar-Cordova E, Rojas-Martinez A, Woo S, Timme T, **Wheeler T**, Thompson T, Scardino P. In situ gene therapy for adenocarcinoma of the prostate: a Phase I clinical trail. *Hum. Gene Ther.*, 10: 1239-1249, 1999.

125. Lotan Y, Xu X, Shalev M, Lotan R, Williams R, **Wheeler T**, Thompson T, Kadmon D: Differential expression of nuclear retinoid receptors in normal and malignant prostates. *J Clin Oncol*, 18: 116-121, 2000.

126. Ayala G, **Wheeler T**: Minimal Diagnostic Criteria for Prostatic Adenocarcinoma in Needle Biopsies. P*athology Case Reviews*, 5: 126-132, 2000.

127. Herman C, Wilcox G, Kattan M, Scardino P, **Wheeler T**: Lymphovascular Invasion as a Predictor of Disease Progression in Prostate Cancer. *Am J Surg Pathol*, 24: 859-863, 2000.

128. Ayala G, **Wheeler T**, Shalev M , Thompson T, Miles B, Cordova E, Chakraborty S, Kadmon D: Cytopathic Effects Associated With HSV-Tk Suicide Gene Therapy For Prostate Cancer. *Human Pathology*, 31: 866-870, 2000.

129. Yang G, Addai J, Ittmann M, **Wheeler T**, Thompson T: Elevated caveolin-1 levels in African-American versus white-American prostate cancer. *Clin Cancer Res*., 6(9): 3430-3, 2000.

130. Stepanova L, Yang G, DeMayo F, **Wheeler T**, Finegold M, Thompson T, Harper J: Induction of human Cdc37 in prostate cancer correlates with the ability of targeted Cdc37 expression to promote prostatic hyperplasia. *Oncogene*, 19(18): 2186-93, 2000.

131. Shariat S, Bergamaschi F, Adler H, Nguyen C, Kattan M, **Wheeler T**: Correlation of preoperative plasma IGF-I levels with pathologic parameters and progression in patients undergoing radical prostatectomy. *Urology*. 56(3): 423-9, 2000.

132. Yang G, Truong L, **Wheeler T,** Thompson T: Caveolin-1 expression in clinically confined human prostate cancer: A novel prognostic marker. *Cancer Res*, 59(22): 5719-23, 2000.

133. Shariat S, Weizer A, Green A, Laucirica R, Frolov A, **Wheeler T**, Lerner S: Prognostic Value of p53 Nuclear Accumulation and Histopathologic Features in T1 Transitional Cell Carcinoma of the Urinary Bladder. *Urology*, 735-740, 2000.

134. Shimura S, Yang G, Ebara S, **Wheeler T**, Frolov A, Thompson T: Reduced infiltration of tumor-associated macrophages in human prostate cancer: Association with cancer progression. *Cancer Res*., 60: 5857-61, 2000.

135. Rabbani F, Stapleton A, Kattan M, **Wheeler T**, Scardino P: Factors predicting recovery of erections after radical prostatectomy. *J Urol.,* 164: 1929-1934, 2000.

136. Slawin K, Shariat S, Nguyen C, Leventis A, Song W, Kattan M, Young C, Tindall D, **Wheeler T:** Detection of Metastatic Prostate Cancer Using a Splice Variant-Specific Reverse Transcriptase-Polymerase Chain Reaction Assay for Human Glandular Kallikrein. *Cancer Research*, 60: 7142-7148, 2000.

137. Allsbrook W, Mangold K, Johnson M, Lane R, Lane C, Amin M, Bostwick D, Humphrey P, Jones E, Reuter V, Sakr W, Sesterhenn I, Troncoso P, **Wheeler T**, Epstein J: Interobserver Reproducibility of Gleason Grading of Prostatic Carcinoma: Urologic Pathologists. *Human Pathology*, 32: 74-80, 2001.

138. Muezzinoglu B, Erdamar S, Chakraborty S, **Wheeler T**: Verumontanum Mucosal Gland Hyperplasia is Associated with Atypical Adenomatous Hyperplasia of the Prostate. *Arch Pathol and Lab Med*, 125:358-60, 2000.

139. Sutton M, Freund C, Berkman S, Dang T, Kattan M, **Wheeler T**, Rowley D, Lerner S: In-Vivo Adenovirus-Mediated Suicide Gene-Therapy Of Orthotopic Bladder-Cancer. *Molecular Therapy*, 2:211, 2000.

140. Ayala G, **Wheeler T**, Shalev M, Thompson T, Miles B, Aguilarcordova E, Chakraborty S, Kadmon D: Cytopathic Effect of In-Situ Gene-Therapy in Prostate-Cancer. *Human Pathology*, 31:866, 2001.

141. Spitz M, Strom S, Yamamura Y, Troncoso P, Babaian R, Scardino P, **Wheeler T**, Amos C, von Eschenbach A: Epidemiologic Determinants of Clinically Relevant Prostate-Cancer. *International Journal of Cancer*, 89:259, 2000.

142. Shappell S, Gupta R, Manning S, Whitehead R, Boeglin W, Schneider C, Case T, Price J, Jack G, **Wheeler T**, Matusik R, Brash A, DuBois R: 15S-Hydroxyeicosatetraenoic Acid Activates Proliferator-activated Receptor y and Inhibits Proliferation in PC3 Prostate Carcinoma Cells. *Cancer Research*, 61:497-503, 2001.

143. Amrikachi M, Ramzy I, Rubenfeld S, **Wheeler T**: Accuracy of Fine Needle Aspiration of Thyroid: A Review of 6226 Cases and Correlation with Surgical/Clinical Outcome. *Arch Pathol and Lab Med*, 125: 484-488, 2001.

144. Gore J, Shariat S, Miles B, Kadmon D, Jiang N, **Wheeler T**, Slawin K. Optimal Combinations of Systematic Sextant and Laterally Directed Biopsies for the Detection of Prostate Cancer. *J Urol*, 165:1554-1559, 2001.

145. Herman C, Kattan M, Ohori M, Scardino P, **Wheeler T**. Primary Gleason pattern as a predictor of disease progression in Gleason score 7 prostate cancer: A multivariate analysis of 823 men treated with radical prostatectomy. *Am J Surg Pathol*, 25(5): 657-660, 2001.

146. Bova G, Parmigiani G, Epstein J, **Wheeler T**, Mucci N, Rubin M: Web-Based Tissue Microarray Image Data Analysis: Initial Validation Testing Through Prostate Cancer Gleason Grading. *Human Pathology*, 32: 417-427, 2001.

147. Maru N, Ohori M, Kattan M, Scardino P, **Wheeler T**. Prognostic Significance of the Diameter of Perineural Invasion in Radical Prostatectomy Specimens. *Human Pathology*, 32:828-833, 2001.

148. Kim J, Shariat S, Kim I, Menesses-Diaz A, Tokunaga H, **Wheeler T**, Lerner S. Predictive Value of Expression of TGFs in Bladder Cancer. *Cancer*, 92(6): 1475-1483, 2001.

149. Malins D, Johnson P, **Wheeler T**, Barker E, Polissar N, Vinson M. Age-related Radical-induced DNA Damage Is Linked to Prostate Cancer. *Cancer Research*, 61:6025-6028, 2001.

150. Ayala G, **Wheeler T**, Shine H, Schmelz M, Frolov A, Chakraborty S, Rowley D: In Vitro Dorsal Root Ganglia and Human Prostate Cell Line Interaction. *The Prostate*, 49:213-223, 2001.

151. Shappell S, Manning S, Boeglin W, Guan Y, Roberts R, Davis L, Olson S, Jack G, Coffey C, **Wheeler T**, Breyer M, Brash A: Alterations in Lipoxygenase and Cyclooxygenase-2 Catalytic Activity and mRNA Expression in Prostate Carcinoma. *Neoplasia*, 3(4):287-303, 2001.

152. Miles B, Shalev M, Aguilar-Cordova E, Timme T, Lee H, Yang G, Adler H, Kernen K, Pramudji C, Satoh T, Gdor Y, Ren C, Ayala G, **Wheeler T**, Butler E, Kadmon D, Thompson T: Prostate-Specific Antigen Response and Systemic T Cell Activation After *In Situ* Gene Therapy in Prostate Cancer Patients Failing Radiotherapy. *Human Gene Therapy*, 12:1955-1967, 2001.

153. Kim J, Shariat S, Kim Y, Menesses-Diaz A, Tokunaga H, **Wheeler T**, Learner S: Predictive Value of Expression of Transforming Growth Factor-β1 and Its Receptors In Transitional Cell Carcinoma of the Urinary Bladder. *Cancer*, 92(6): 1475-1483, 2001.

154. Shariat S, Andrews B, Kattan M, Kim J, **Wheeler T**, Slawin, K: Plasma Levels of Interleukin-6 and its Soluble Receptor are Associated With Prostate Cancer Progression and Metastasis. *Urology*, 58(6): 1007-1015, 2001.

155. Kothari P, Scardino P, Ohori M, Kattan M, **Wheeler T:** Incidence, Location and Significance of Periprostatic and Periseminal Vesicle Lymph Nodes in Prostate Cancer. *Am J Surg Pathol.*, 25(11): 1429-1432, 2001.

156. Shariat S, Andrews B, Kattan M, Kim J, **Wheeler T**, Slawin M: Plasma levels of interleukin-6 and its soluble receptor are associated with prostate cancer progression and metastasis. *Urology*, Dec;58(6):1008-15, 2001.

157. Thompson T, Timme T, Ebara S, Satoh T, Yang G, Wang J, Miles B, Ayala G, **Wheeler T**, Kadmon D. In situ gene therapy for prostate cancer: immunomodulatory approaches. *Expert Opin Biol Ther.*, May:1(3):481-95, 2001.

158. Teh B, Aguilar-Cordova E, Kernen K, Chou C, Shalev M, Vlachaki M, Miles B, Kadmon D, Mai W, Caillouet J, Davis M, Ayala G, **Wheeler T**, Brady J, Carpenter L, Lu H, Chiu J, Woo S, Thompson T, Butler E. Phase I/II trial evaluating combined radiotherapy and in situ gene

therapy with or without hormonal therapy in the treatment of prostate cancer--a preliminary report. *Int J Radiat Oncol Biol Phys*. Nov 1;51(3):605-13, 2001.

159. Shariat S, Kim J, Andrews B, Kattan M, **Wheeler T**, Kim I, Lerner S, Slawin K. Preoperative plasma levels of transforming growth factor β1 (TGF- β1) strongly predict progression in patients undergoing radical prostatectomy. *J Clin Oncol.,* Jun 19(11):2856-64, 2001.

160. Kim E, Nath R, Kadmon D, Lipshultz L, Miles B, Slawin K, Tang H, **Wheeler T**, Scardino P. Bilateral nerve graft during radical retropubic prostatectomy: 1-year follow-up. J *Urol*. Jun 6(1):1950-6, 2001.

161. Muezzinoglu B, Erdamar S, Chakraborty S, **Wheeler T**. Verumontanum mucosal gland hyperplasia is associated with atypical adenomatous hyperplasia of the prostate. *Arch Pathol Lab Med*. Mar 125(3):358-60 2001.

162. Leventis A, Shariat S, Kattan M, Butler E, **Wheeler T**, Slawin K. Prediction of response to salvage radiation therapy in patients with prostate cancer recurrence after radical prostatectomy. *J Clin Oncol.,* Feb 19(4):1030-9, 2001.

163. Allsbrook W, Mangold K, Johnson M, Lane R, Lane C, Amin M, Bostwick D, Humphrey P, Jones E, Reuter V, Sakr W, Sesterhenn I, Troncoso P, **Wheeler T**, Epstein J. Interobserver reproducibility of Gleason grading of prostatic carcinoma: urologic pathologists. *Hum Pathol*. Jan 32(1):74-80, 2001.

164. Chang S, Hursting S, Contois J, Strom S, Yamamura Y, Babaian R, Troncoso P, Scardino P, **Wheeler T**, Amos C, Spitz M. Leptin and prostate cancer. *Prostate*. Jan 46(1):62-7, 2001.

165. Shappell S, Manning S, Boeglin W, Guan Y, Roberts R, Davis L, Olson S, Jack G, Coffey C, **Wheeler T**, Breyer M, Brash A. Alterations in lipoxygenase and cyclooxygenase-2 catalytic activity and mRNA expression in prostate carcinoma. *Neoplasia*. 3(4):287-303, 2001.

166. Shariat S, Shalev M, Menesses-Diaz A, Kim I, Kattan M, **Wheeler T**, Slawin K. Preoperative plasma levels of transforming growth factor beta(1) (TGF-beta((1)) strongly predict progression in patients undergoing radical prostatectomy. *J Clin Oncol*, 19(11): 2856-64, 2001.

167. Byrne RR, Shariat SF, Brown R, Kattan MW, Morton RA JR, **Wheeler TM**, Lerner SP. E-Cadherin Immunostaining of Bladder Transitional Cell Carcinoma, Carcinoma In Situ and Lymph Node Metastases With Long-Term Followup. *J Urol.* 2001 May;165(5):1473-9.

168. Shariat SF, Pahlavan S, Baseman AG, Brown RM, Green AE, **Wheeler TM**, Lerner SP. E-cadherin expression predicts clinical outcome in carcinoma in situ of the urinary bladder. *Urology*. 2001 Jan;57(1):60-5.

169. Hull G, Rabbani F, Abbas F, **Wheeler T**, Kattan M, Scardino P. Cancer control with radical prostatectomy alone in 1,000 consecutive patients. *J Urol*.167(2, Pt 1): 528-34, 2002.

170. Andrews B, Shariat S, Kim J, **Wheeler T**, Slawin K, Lerner S. Preoperative plasma levels of interleukin-6 and its soluble receptor predict disease recurrence and survival of patients with bladder cancer. *J Urol*. March 167:1475-1481, 2002.

171. Slawin K, Canto E, Shariat S, Gore J, Kim E, Kattan M, **Wheeler T,** Nath R. Sural Nerve Interposition Grafting During Radical Prostatectomy. *Reviews in Urology*. 4(1):17-23, 2002.

172. Ling S, Kothari P, **Wheeler T**, Reese T, Connelly J. Cytokeratins 7 and 20 Immunoreactivity in Chromophobe Renal Cell Carcinomas and Renal Oncocytomas. *Modern Pathology*. 15:712-717, 2002.

173. Shariat S, Gottenger E, Nguyen C, Song W, Kattan M, Andenoro J, **Wheeler T**, Spencer D, Slawin K. Preoperative Blood Reverse Transcriptase-PCR Assays for Prostate-specific Antigen and Human Glandular Kallikrein for Prediction of Prostate Cancer Progression after Radical Prostatectomy. *Cancer Research.* 62: 5974–5979, 2002.

174. Yossepowitch O, Sircar K, Scardino P, Ohori M, Kattan M, **Wheeler T**, Reuter V. Bladder Neck Involvement in Pathological Stage pT4 Radical Prostatectomy Specimens Is Not an Independent Prognostic Factor. *The Journal of Urology*. 168: 2011-2015, 2002.

175. Mouraview V, Salahaldin T, Yang G, Timme T, Goltsov A, Ren C, Satoh T, **Wheeler T**, Ittmann M, Miles B, Amato R, Kadmon D, Thompson T. The Role of Caveolin-1 in Androgen Insensitive Prostate Cancer. *The Journal of Urology*. 168: 1589-1596, 2002.

176. Cagiannos I, Graefen M, Karakiewicz P, Ohori M, Eastham J, Rabbani F, Fair W, **Wheeler T**, Hammerer P, Haese A, Erbersdobler A, Huland H, Scardino P, Kattan M. An Analysis of Clinical Stage T2 Prostate Cancer: Do Current Subclassifications Represent an Improvement? *Journal of Clinical Oncology,*20(8): 2025-30, 2002.

177. Shariat S, Lamb D, Kattan M, Nguyen C, Kim J, Beck J, **Wheeler T**, Slawin K: Association of Pre-operative Plasma Levels of Insulin-like Growth Factor I and Insulin-like Growth Factor Binding Proteins -2 and -3 with Prostate Cancer Invasion, Progression, and Metastasis: *Journal of Clinical Oncology,* 20(3): 833-41, 2002.

178. Yang G, Ayala G, Marzo A, Tian W, Frolov A, **Wheeler T**, Thompson T, Harper J: Elevated Skp2 protein expression in human prostate cancer: association with loss of the cyclin-dependent kinase inhibitor p27 and PTEN and with reduced recurrence-free survival. *Clin Cancer Res*, 8(11):3419-26, 2002.

179. Teh B, Aguilar-Cordova E, Vlachaki M, Aguilar L, Mai W, Caillouet J, Davis M, Miles B, Kadmon D, Ayala G, Lu H, Chiu J, Carpenter L, Woo S, Grant W, **Wheeler T**, Thompson T, Butler E: Combining radiotherapy with gene therapy (from the bench to the bedside): a novel treatment strategy for prostate cancer. *Oncology*, 7(5):458-66, 2002.

180. Wu S, Kothari P, **Wheeler T**, Reese T, Connelly J: Cytokeratins 7 and 20 immunoreactivity in chromophobe renal cell carcinomas and renal oncocytomas. *Mod Pathol*, 15(7): 712-7, 2002.

181. Koh H, Maru N, Muramoto M, **Wheeler TM**, Scardino PT, Ohori M. The 1992 TNM classification of T2 prostate cancer predicts pathologic stage and prognosis better than the revised 1997 classification. *Nihon Hinyokika Gakkai Zasshi*. 2002 Jul;93(5):595-601. [Article in Japanese]

182. Ohori M, Kattan M, Utsunomiya T, Suyama K, Scardino P, **Wheeler T**. Do impalpable (T1c) cancers visible on ultrasound differ from those not visible? *J. Urol* 169(3):964-968, 2003.

183. Shariat S, Kim J, Ayala G, Kho K, **Wheeler T**, Lerner S. Cyclooxygenase-2 Is Highly Expressed In Carcinoma In Situ And T1 Transitional Cell Carcinoma Of The Bladder. *J Urol*, 169:938-942, 2003.

184. Shariat S, Kim J, Nguyen C, **Wheeler T**, Lerner S, Slawin K: Correlation of preoperative plasma levels of IGF-I and IGFBP-3 with Pathologic Parameters and clinical outcome in patients with bladder cancer. *Urology*, 61(2): 359-364, 2003.

185. Shariat S, Kattan M, Erdamar S, Nguyen C, Scardino P, Spencer D, **Wheeler T**, Slawin K: Detection of Clinically Significant, Occult Prostate Cancer Metastases in Lymph Nodes Using a Splice Variant-Specific RT-PCR Assay for Human Glandular Kallikrein. *J Clin Onc*, 21(7): 1223-1231, 2003.

186. Malins D, Johnson P, Barker E, Polissar N, **Wheeler T**, Anderson K: Cancer-related changes in prostate DNA as men age and early identification of metastasis in primary prostate tumors. *PNAS*, 100(9): 5401-5406, 2003.

187. Li R, **Wheeler T**, Dai H, Ayala G: Neural cell adhesion molecule is upregulated in nerves with prostate cancer invasion. *Hum Pathol*, 34(5): 457-61, 2003.

188. Shariat S, Monoski M, Andrews B, **Wheeler T**, Lerner S, Slawin K: Association of plasma urokinase-type plasminogen activator and its receptor with clinical outcome in patients undergoing radical cystectomy for transitional cell carcinoma of the bladder. *Urology,* 61(5):1053-8, 2003.

189. Teh B, Bastasch M, **Wheeler T**, Mai W, Frolov A, Uhl B, Lu H, Carpenter L, Chiu J, McGary J, Woo S, Grant H, Butler E: IMRT for prostate cancer: defining target volume based on correlated pathologic volume of disease. *Int J Radiat Oncol Biol Phys*, 56(1):184-91, 2003.

190. Cornell R, Rowley D, **Wheeler T**, Ali N, Ayala G. Neuroepithelial interactions in prostate cancer are enhanced in the presence of prostatic stroma. *Urology*, 61(4):870-5, 2003.

191. Ayala G, Tuxhorn JA, Wheeler M, Frolov A, Scardino PT, Ohori M, **Wheeler TM**, Spitler J, Rowley DR. Reactive Stroma as a Predictor of Biochemical-Free Recurrence in Prostate Cancer, *Clin Cancer Res*. 9(13):4792-4801, 2003.

192. Ayala G, Wang D, Wulf G, Frolov A, Li R, Sowadski J, **Wheeler TM**, Lu KP, Bao L. The prolyl isomerase Pin1 is a novel prognostic marker in human prostate cancer. *Cancer Res*, 63(19):6244-51, 2003.

193. Li R, Younes M, Frolov A, **Wheeler TM**, Scardino P, Ohori M, Ayala G**.** Expression of neutral amino acid transporter ASCT2 in human prostate. *Anticancer Res*, 23(4):3413-8, 2003.

194. Cornell RJ, Rowley D, **Wheeler TM**, Ali N, Ayala G. Neuroepithelial interactions in prostate cancer are enhanced in the presence of prostatic stroma. *Urology*, (4):870-5, 2003.

195. Tahir SA, Ren C, Timme TL, Gdor Y, Hoogeveen R, Morrisett JD, Frolov A, Ayala G, **Wheeler TM**, Thompson TC. Development of an immunoassay for serum caveolin-1: a novel biomarker for prostate cancer. *Clin Cancer Res*, 9(10 Pt 1):3653-9, 2003.

196. Shariat SF, Kim JH, Ayala GE, Kho K, **Wheeler TM**, Lerner SP. Cyclooxygenase-2 is highly expressed in carcinoma in situ and T1 transitional cell carcinoma of the bladder. *J Urol*, 69(3):938-42, 2003.

197. Matsumoto K, Shariat SF, Casella R, **Wheeler TM**, Slawin KM, Lerner SP. Preoperative plasma soluble E-Cardherin predicts metastases to lymph nodes and prognosis in patients undergoing radical cystectomy. *J Urol*, 07:16:31, 2003.

198. Krouskop TA, Younes PS, Srinivasan S, **Wheeler TM**, Ophir J. Differences in the compressive stress-strain response of infiltrating ductal carcinomas with and without lobular features-implications for mammography and elastography. *Ultrasonic Imaging*, 25, 109-121, 2003.

199. Shariat SF, Kattan MW, Song W, Bernard D, Gottenger E, **Wheeler TM**, Slawin KM. Early postoperative peripheral blood reverse transcription PCR assay for prostate-specific antigen is associated with prostate cancer progression in patients undergoing radical prostatectomy. *Cancer Res*. 2003 Sep 15;63(18):5874-8.

200. Shariat S, Roudier M, Wilcox G, Kattan M, Scardino P, Vessella R, Erdamar S, Nguyen C, **Wheeler T**, and Slawin K: Comparison of immunohistochemistry with reverse transcription-PCR for the detection of micrometastatic prostate cancer in lymph nodes. *Cancer Res*, 63(15): 4662-70, 2003.

201. Kattan MW, Shariat SF, Andrews B, Zhu K, Canto E, Matsumoto K, Muramoto M, Scardino PT, Ohori M, **Wheeler TM**, Slawin KM. The Addition of Interleukin-6 Soluble Receptor and Transforming Growth Factor Beta1 Improves a Preoperative Nomogram for Predicting Biochemical Progression In Patients With Clinically Localized Prostate Cancer. *J Clin Oncol*. 2003 Oct 1;21(19):3573-9. Epub 2003 Aug 11.

202. Teh BS, Bastasch MD, Mai WY, Butler EB, **Wheeler TM**. Predictors of Extracapsular Extension and its Radial Distance in Prostate Cancer: Implications for Prostate IMRT, Brachytherapy, and Surgery. *Cancer J*, 9(6):454-60, 2003.

203. Koh H, Kattan MW, Scardino PT, Suyama K, Maru N, Slawin K, **Wheeler TM**, Ohori M. A Nomogram to Predict Seminal Vesicle Invasion by the Extent and Location of Cancer in Systematic Biopsy Results. *J Urol*. 2003 Oct;170(4 Pt 1):1203-8.

204. Kattan MW, Eastham JA, **Wheeler TM**, Maru N, Scardino PT, Erbersdobler A, Graefen M, Huland H, Koh H, Shariat S, Slawin KM, Ohori M. Counseling Men with Prostate Cancer: A Nomogram for Predicting the Presence of Small, Moderately Differentiated, Confined Tumors. *J Urol.* 2003 Nov;170(5):1792-7.

205. Eastham JA, Kattan MW, Riedel E, Begg CB, **Wheeler TM**, Gerigk C, Gonen M, Reuter V, Scardino PT. Variations Among Individual Surgeons in the Rate of Positive Surgical Margins in Radical Prostatectomy Specimens. *J Urol.* 2003 Dec;170(6 Pt 1):2292-5.

206. Li R, Younes M, **Wheeler TM**, Scardino P, Ohori M, Frolov A, Ayala G. Expression of Vascular Endothelial Growth Factor Receptor-3 (VEGFR-3) in Human Prostate. *Prostate,* 58:193-199, 2004.

207. Shariat SF, Anwuri VA, Lamb DJ, Shah NV, **Wheeler TM**, Slawin KM. Association of preoperative plasma levels of vascular endothelial growth factor and soluble vascular cell adhesion molecule-1 with lymph node status and biochemical progression after radical prostatectomy. *J Clin Oncol*, 1;22(9):1655-63, 2004.

208. Teh BS, Butler EB, **Wheeler TM**. In response to Dr. Macias. *Int J Radiat Oncol Biol Phys*, 1;59(1):321-2 2004.

209. Singh H, Canto EI, Shariat SF, Kadmon D, Miles BJ, **Wheeler TM**, Slawin KM. Predictors of prostate cancer after initial negative systematic 12 core biopsy. *J Urol*, 171(5):1850-4, 2004.

210. Ohori M, Kattan MW, Koh H, Maru N, Slawin KM, Shariat S, Muramoto M, Reuter VE, **Wheeler TM**, Scardino PT. Predicting the presence and side of extracapsular extension: a nomogram for staging prostate cancer. *J Urol*, 171(5):1844-9, 2004.

211. Yang G, Addai J, Tian WH, Frolov A, **Wheeler TM**, Thompson TC. Reduced infiltration of class A scavenger receptor positive antigen-presenting cells is associated with prostate cancer progression. *Cancer Res*, 15;64(6):2076-82, 2004.

212. Shariat SF, Kattan MW, Traxel E, Andrews B, Zhu K, **Wheeler TM**, Slawin KM. Association of pre- and postoperative plasma levels of transforming growth factor beta(1) and interleukin 6 and its soluble receptor with prostate cancer progression. *Clin Cancer Res*, 15;10(6):1992-9, 2004.

213. Singh H, Canto EI, Shariat SF, Kadmon D, Miles BJ, **Wheeler TM**, Slawin KM. Improved detection of clinically significant, curable prostate cancer with systematic 12-core biopsy. *J Urol*, 171(3):1089-92, 2004.

214. Patel MI, DeConcini DT, Lopez-Corona E, Ohori M, **Wheeler T**, Scardino PT. An Analysis of Men with Clinically Localized Prostate Cancer Who Deferred Definitive Therapy. *J Urol.* 2004 Apr;171(4):1520-4.

215. Ohori M, Kattan M, Scardino PT, **Wheeler TM**. Radical prostatectomy for carcinoma of the prostate. *Mod Pathol*, 17(3):349-59, 2004.

216. Li R, Younes M, **Wheeler TM**, Scardino P, Ohori M, Frolov A, Ayala G. Expression of vascular endothelial growth factor receptor-3 (VEGFR-3) in human prostate. *Prostate*, 1;58(2):193-9, 2004.

217. Singh H, Canto EI, Shariat SF, Kadmon D, Miles BJ, **Wheeler TM**, Slawin KM. Six additional systematic lateral cores enhance sextant biopsy prediction of pathological features at radical prostatectomy. *J Urol*, 171(1):204-9, 2004.

218. Graefen M, Ohori M, Karakiewicz PI, Cagiannos I, Hammerer PG, Haese A, Erbersdobler A, Henke RP, Huland H, **Wheeler TM**, Slawin K, Scardino PT, Kattan MW. Assessment of the enhancement in predictive accuracy provided by systematic biopsy in predicting outcome for clinically localized prostate cancer. *J Urol*, 171(1):200-3, 2004.

219. Shariat SF, Ansuri VA, Lamb DJ, Shah NV, **Wheeler TM**, Slawin KM. Association of Preoperative Plasma Levels of Vascular Endothelial Growth Factor and Soluble Vascular Cell Adhesion Molecule-1 With Lymph Node Status and Biochemical Progression After Radical Prostatectomy. *JCO*, 1655-1663, 2004.

220. Malins DC, Gilman NK, Green VM, **Wheeler TM**, Barker EA, Vinson, MA, Sayeeduddin M, Hellstrom KE, Anderson KM. Metastatic Cancer DNA Phenotype Identified in Normal Tissues Surrounding Metastasizing Prostate Carcinomas. *PNAS*, 101(31) 11428-31, 2004.

221. Shariat SF, Menesses-Diaz A, Kim IY, Kattan MW, Muramoto M, Sayeeddudin M, **Wheeler TM**, Slawin KM. Tissue expression of transforming growth factor-beta1 and its receptors: correlation with pathologic features and biochemical progression in patients undergoing radical prostatectomy. *Urology*, 63(6):1191-7, 2004.

222. Eid W, **Wheeler TM**, Sharma MD. Recurrent hypercalcemia due to ectopic production of parathyroid hormone-related protein and intact parathyroid hormone in a single patient with multiple malignancies. *Endocr*, 10(2):125-8, 2004.

223. Kikuchi E, Scardino PT, **Wheeler TM**, Slawin KM, Ohori M. Is tumor volume an independent prognostic factor in clinically localized prostate cancer? *J Urol*. 172(2):508-11, 2004.

224. McAlhany SJ, Ayala GE, Frolov A, Ressler SJ, **Wheeler TM**, Watson JE, Collins C, Rowley DR. Decreased stromal expression and increased epithelial expression of WFDC1/ps20 in prostate cancer is associated with reduced recurrence-free survival. *Prostate*. 61(2):182-91, 2004.

225. Canto EI, Singh H, Shariat SF, Kadmon D, Miles BJ, **Wheeler TM**, Slawin KM. Effects of systematic 12-core biopsy on the performance of percent free prostate specific antigen for prostate cancer detection. *J Urol*. 172(3):900-4, 2004.

226. Ayala GE, Dai H, Ittmann M, Li R, Powell M, Frolov A, **Wheeler TM**, Thompson TC, Rowley D. Growth and survival mechanisms associated with perineural invasion in prostate cancer. *Cancer Res*. 64(17):6082-90, 2004.

227. Adler HL, Haddad JL, **Wheeler TM**, Kim ED. Intratesticular adenomatoid tumor radiographically mimicking a primary testicular malignancy. *Scientific World Journal.* 4 Suppl 1:11-5, 2004.

228. Singh H, Canto EI, Shariat SF, Kadmon D, Miles BJ, **Wheeler TM**, Slawin KM. Predictors of prostate cancer after initial negative systematic 12 core biopsy. *J Urol*. 171(5):1850-4, 2004.

229. Cagiannos I, Karakiewicz P, Graefen M, Eastham JA, Ohori M, Rabbani F, Reuter V, **Wheeler T**, Kupelian P, Klein E, Huland H, Hammerer PG, Erbersdobler A, Schroeder F, Wildhagen M, Quinn DI, Henshall SM, Grygiel JJ, Sutherland RL, Stricker PD, Morash CG, Scardino PT, Kattan MW. Is Year Of Radical Prostatectomy a Predictor Of Outcome in Prostate Cancer. *J Urol.* 2004 Feb;171(2 Pt 1):692-6.

230. Satoh T, Teh BS, Timme TL, Mai WY, Gdor Y, Kusaka N, Fujita T, Pramudji CK, Vlachaki MT, Ayala G, **Wheeler T**, Amato R, Miles BJ, Kadmon D, Butler EB, Thompson TC.

Enhanced systemic T-cell activation after in situ gene therapy with radiotherapy in prostate cancer patients. *Int J Radiat Oncol Biol Phys*. 59(2):562-71, 2004.

231. Li R, **Wheeler T**, Dai H, Frolov A, Thompson T, Ayala G. High level of androgen receptor is associated with aggressive clinicopathologic features and decreased biochemical recurrence-free survival in prostate: cancer patients treated with radical prostatectomy. *Am J Surg Pathol*. 28(7):928-34, 2004.

232. Ayala G, Thompson T, Yang G, Frolov A, Li R, Scardino P, Ohori M, **Wheeler T**, Harper W. High levels of phosphorylated form of Akt-1 in prostate cancer and non-neoplastic prostate tissues are strong predictors of biochemical recurrence. *Clin Cancer Res*. 10(19):6572-8, 2004.

233. Kamat AA, Younes PS, Sayeeduddin M, **Wheeler TM**, Simpson JL, Agoulnik AI. Protein expression profiling of endometriosis: validation of 2-mm tissue microarrays. *Fertil Steril*. 82(6):1681-3, 2004.

234. Yang G, Timme TL, Frolov A, **Wheeler TM**, Thompson TC. Combined c-Myc and caveolin-1 expression in human prostate carcinoma predicts prostate carcinoma Progression. *Cancer*. 103(6): 1186-1194, 2005.

235. Li L, Ittmann MM, Ayala G, Tsai MJ, Amato RJ, **Wheeler TM**, Miles BJ, Kadmon D, Thompson TC. The emerging role of the PI3-K-Akt pathway in prostate cancer progression. *Prostate Cancer Prostatic Dis.* 8(2):108-118, 2005.

236. Amrikachi M, Ponder TB, **Wheeler TM**, Smith D, Ramzy I. Thyroid fine-needle aspiration biopsy in children and adolescents: experience with 218 aspirates. *Diagn Cytopathol.* 32(4):189-192, 2005.

237. Powell MS, Li R, Dai H, Sayeeduddin M, **Wheeler TM**, Ayala GE. Neuroanatomy of the normal prostate. *Prostate*. 2005 Sep 15;65(1):52-7.

238. Srigley JR, Amin M, Boccon-Gibod L, Egevad L, Epstein JI, Humphrey PA, Mikuz G, Newling D. Nilsson S, Sakr W, **Wheeler TM**, Montironi R. Prognostic and predictive factors in prostate cancer: historical perspective and recent international consensus initiatives. *Scandinavian J Urol Neph.* 39(Suppl 216): 8-19, 2005.

239. Amin M, Boccon-Gibod L, Egevad L, Epstein JI, Humphrey PA, Mikuz G, Newling D. Nilsson S, Sakr W, Srigley JR, **Wheeler TM**, Montironi R. Prognostic and predictive factors and reporting of prostate carcinoma in prostate needle biopsy specimens. *Scandinavian J Urol Neph*. 39(Suppl 216): 20-33, 2005.

240. Epstein JI, Amin M, Boccon-Gibod L, Egevad L, Humphrey PA, Mikuz G, Newling D, Nilsson S, Sakr W, Srigley JR, **Wheeler TM**, Montironi R. Prognostic factors and reporting of prostate carcinoma in radical prostatectomy and pelvic lymphadenectomy specimens. *Scandinavian J Urol Neph.* 39(Suppl 216): 34-63, 2005.

241. Shariat SF, Andrews B, Anwuri VA, Naderi ASA, Miles BJ, Roth D, **Wheeler TM**, Slawin KM: Anomalies of the Wolffian duct derivatives encountered at radical prostatectomy. *Reviews in Urology*, 7:75-80, 2005.

242. Swindle P, Eastham JA, Ohori M, Kattan MW, **Wheeler T**, Maru N, Slawin K, Scardino PT. Do margins matter? The prognostic significance of positive surgical margins in radical prostatectomy specimens. *J Urol*., 174(3):903-907, 2005.

243. Ramasubbu K, **Wheeler TM**, Reardon MJ, Dokainish H. Visceral pericardial hemangioma: unusual location for a rare cardiac tumor. *J Am Soc Echocardiogr*. 2005 Sep;18(9):981.

244. Haqq C, Li R, Khodabakhsh D, Frolov A, Ginzinger D, Thompson T, **Wheeler T**, Carroll P, Ayala G. Ethnic and racial differences in prostate stromal estrogen receptor alpha. *Prostate*. 2005 Oct 1;65(2):101-9

245. Dai H, Li R, **Wheeler T**, Diaz de Vivar A, Frolov A, Tahir S, Agoulnik I, Thompson T, Rowley D, Ayala G. Pim-2 upregulation: biological implications associated with disease progression and perinueral invasion in prostate cancer. *Prostate*. 2005 Nov 1;65(3):276-86.

246. Anton RC, **Wheeler TM**. Frozen Section of Thyroid and Parathyroid Specimens. *Arch Pathol Lab Med*. 2005 Dec; 129(12):1575-1584.

247. Malins DC, Gilman NK, Green VM, **Wheeler TM**, Barker EA, Anderson KA. A cancer DNA phenotype in healthy prostates, conserved in tumors and adjacent normal cells, implies a relationship to carcinogenesis. *PNAS*. 2005 Dec; 102(52):19093-19096.

248. Tetzlaff MT, Teh BS, Timme TL, Fujita T, Satoh T, Tabata K, Mai WY, Vlachaki MT, Amato RJ, Kadmon D, Miles BJ, Ayala G, **Wheeler TM**, Aguilar-Cordova E, Thompson TC, Butler EB. Expanding the therapeutic index of radiation therapy by combining in situ gene therapy in the treatment of prostate cancer. *Technol Cancer Res Treat* 5(1):23-26, 2006

249. Ayala GE, Dai H, Li R, Ittmann M, Thompson TC, Rowley D, **Wheeler TM**. Bystin in perineural invasion of prostate cancer. *Prostate.* 2006 Feb 15;66(3):266-72.

250. Li R, **Wheeler TM**, Dai H, Sayeeduddin M, Scardino PT, Frolov A, Ayala GE. Biological correlates of p27 compartmental expression in prostate cancer. *J Urol*. 2006 Feb;175(2):528-32.

251. Mims MP, Hayes TG, Zheng S, Leal SM, Frolov A, Ittmann MM, **Wheeler TM**, Prchal JT. Mitochondrial DNA G10398A polymorphism and invasive breast cancer in African-American women. *Cancer Res*. 2006 Feb 1;66(3):1880; author reply 1880-1

252. Lopez-Corona E, Ohori M, **Wheeler TM**, Reuter VE, Scardino PT, Kattan MW, Eastham JA. Prostate cancer diagnosed after repeat biopsies have a favorable pathological outcome but similar recurrence rate. *J Urol*. 2006 Mar;175(3 Pt 1):923-7; discussion 927-8.

253. Ayala G, Satoh T, Li R, Shalev M, Gdor Y, Aguilar-Cordova E, Frolov A, **Wheeler TM**, Miles BJ, Rauen K, Teh BS, Butler EB, Thompson TC, Kadmon D. Biological response determinants in HSV-tk + Ganciclovir gene therapy for prostate cancer. *Mol Ther*. 2006 April;13(4):716-728.

254. Ayala GE, Dai H, Tahir SA, Li R, Timme T, Ittmann M, Frolov A, **Wheeler TM**, Rowley D, Thompson TC. Stromal antiapoptotic paracrine loop in perineural invasion of prostatic carcinoma. *Cancer Res.* 2006 May 15;66(10):5159-64.

255. Secin FP, Bianco FJ Jr, Vickers AJ, Reuter V, **Wheeler T**, Fearn PA, Eastham JA, Scardino PT. Cancer-Specific Survival and Predictors of Prostate-Specific Antigen Recurrence and Survival in Patients with Seminal Vesicle Invasion after Radical Prostatectomy. *Cancer*. 2006 Jun 1;106(11):2369-75.

256. Shen SS, Lerner SP, Muezzinoglu B, Truong LD, Amiel G, **Wheeler TM**. Prostatic involvement by transitional cell carcinoma in patients with bladder cancer and its prognostic significance. *Hum Pathol*. 2006 Jun;37(6):726-34.

257. Srigley JR, Amin MB, Epstein JI, Grignon DJ, Humphrey PA, Renshaw AA, **Wheeler TM**; Members of the Cancer Committee, College of American Pathologists. Updated protocol for the examination of specimens from patients with carcinomas of the prostate gland. *Arch Pathol Lab Med*. 2006 Jul;130(7):936-46.

258. Tahir SA, Frolov A, Hayes TG, Mims MP, Miles BJ, Lerner SP, **Wheeler TM**, Ayala G, Thompson TC, Kadmon D. Preoperative serum caveolin-1 as a prognostic marker for recurrence in a radical prostatectomy cohort. *Clin Cancer Res*. 2006 Aug 15;12(16):4872-5.

259. Donohue JF, Bianco FJ Jr, Kuroiwa K, Vickers AJ, **Wheeler TM**, Scardino PT, Reuter VA, Eastham JA. Poorly differentiated prostate cancer treated with radical prostatectomy: long-term outcome and incidence of pathological downgrading. *J Urol*. 2006 Sep;176(3):991-5.

260. Hammerich KH, Slawin KM, **Wheeler TM**. Prognostic indicators for disease progression following radical prostatectomy. *Nat Clin Pract Urol*. 2006 Dec;3(12):638-9.

261. Wolff AC, Hammond EH, Schwartz JN, Hagerty KL, Allred DC, Cote RJ, Dowsett M, Fitzgibbons PL, Hanna WM, Langer A, McShane LM, Paik S, Pegram MD, Perez WA, Press MF, Rhodes A, Sturgeon C, Taube SE, Tubbs R, Vance GH, van de Vijver M, **Wheeler TM**, Hayes DF. American Society of Clinical Oncology/College of American Pathologists Guidelines Recommendations for Human Epidermal Growth Factor Receptor 2 Testing in Breast Cancer. *J Clin Oncol*. 2007 Jan 1;25(1):118-45.

262. Shariat SF, Roehrborn CG, McConnell JD, Park S, Alam N, **Wheeler TM**, Slawin KM. Association of the circulating levels of the urokinase system of plasminogen activation with the presence of prostate cancer and invasion, progression, and metastasis. *J Clin Oncol*. 2007 Feb 1;25(4):349-55.

263. Dai H, Li R, **Wheeler T**, Ozen M, Ittmann M, Anderson M, Wang Y, Rowley D, Younes M, Ayala GE. Enhanced survival in perineural invasion of pancreatic cancer: an in vitro approach. *Hum Pathol*. 2007 Feb;38(2):299-307..

264. Cordon-Cardo C, Kotsianti A, Verbel DA, Teverovskiy M, Capodieci P, Hamann S, Jeffers Y, Clayton M, Elkhettabi F, Khan FM, Sapir M, Bayer-Zubek V, Vengrenyuk Y, Fogarsi S, Saidi O, Reuter VE, Scher HI, Kattan MW, Bianco FJ, **Wheeler TM**, Ayala GE, Scardino PT, Donovan MJ. Improved prediction of prostate cancer recurrence through systems pathology. *J Clin Invest*. 2007 Jul;117(7):1876-83.

265. Kwabi-Addo B, Chung W, Shen L, Ittmann M, **Wheeler T**, Jelinek J, Issa JP. Age-related DNA methylation changes in normal human prostate tissues. *Clin Cancer Res*. 2007 Jul

1;13(13):3796-802.

266. Cohen RJ, **Wheeler TM**, Bonkhoff H, Rubin MA. A proposal on the identification, histologic reporting, and implications of intraductal prostatic carcinoma. *Arch Pathol Lab Med*. 2007 Jul;131(7):1103-9. Review.

267. Ishii J, Ohori M, Scardino P, Tsuboi T, Slawin K, **Wheeler T**. Significance of the craniocaudal distribution of cancer in radical prostatectomy specimens. *Int J Urol*. 2007 Sep;14(9):817-21.

268. Li R, Erdamar S, Dai H, **Wheeler TM**, Frolov A, Scardino PT, Thompson TC, Ayala GE. Forkhead protein FKHR and its phosphorylated form p-FKHR in human prostate cancer. *Hum Pathol*. 2007 Oct;38(10):1501-7.

269. Yang G, Addai J, **Wheeler TM**, Frolov A, Miles BJ, Kadmon D, Thompson TC. Correlative evidence that prostate cancer cell-derived caveolin-1 mediates angiogenesis. *Hum Pathol*. 2007 Nov;38(11):1688-95.

270. Yanagisawa N, Li R, Rowley D, Hao L, Kadmon D, Miles BJ, **Wheeler TM**, Ayala GE. Stromogenic prostatic carcinoma pattern (carcinomas with reactive stromal grade 3) in needle biopsies predicts biochemical recurrence-free survival in patients after radical prostatectomy. *Hum Pathol*. 2007 Nov;38(11):1611-20.

271. Eastham JA, Kuroiwa K, Ohori M, Serio AM, Gorbonos A, Maru N, Vickers AJ, Slawin KM, **Wheeler TM**, Reuter VE, Scardino PT. Prognostic significance of location of positive margins in radical prostatectomy specimens. *Urology*. 2007 Nov;70(5):965-9.

272. Kiniwa Y, Miyahara Y, Wang HY, Peng W, Peng G, **Wheeler TM**, Thompson TC, Old LJ, Wang RF. CD8+ Foxp3+ Regulatory T Cells Mediate Immunosuppression in Prostate Cancer. *Clin Cancer Res*. 2007 Dec 1;13(23):6947-58.

273. Eggener SE, Scardino PT, Carroll PR, Zelefsky MJ, Sartor O, Hricak H, **Wheeler TM**, Fine SW, Trachtenberg J, Rubin MA, Ohori M, Kuroiwa K, Rossignol M, Abenhaim L; International Task Force on Prostate Cancer and the Focal Lesion Paradigm. Focal Therapy for Localized Prostate Cancer: A Critical Appraisal of Rationale and Modalities. *J Urol*. 2007 Dec;178(6):2260-7

274. Yanagisawa N, Li R, Rowley D, Liu H, Kadmon D, Miles BJ, **Wheeler TM**, Ayala GE. Reprint of: Stromogenic prostatic carcinoma pattern (carcinomas with reactive stromal grade 3) in needle biopsies predicts biochemical recurrence-free survival in patients after radical prostatectomy. *Hum Pathol*. 2008 Feb;39(2):282-91.

275. Hammerich KH, Ayala GE, **Wheeler TM**. Application of Immunohistochemistry to the Genitourinary System (Prostate, Urinary Bladder, Testis, and Kidney). *Arch Pathol Lab Med.* 2008 Mar;132(3):432-40.

276. Swindle P, Eastham JA, Ohori M, Kattan MW, **Wheeler T**, Maru N, Slawin K, Scardino PT. Do margins matter? The prognostic significance of positive surgical margins in radical prostatectomy specimens. *J Urol*. 2008 May;179(5 Suppl):S47-51.

277. Cohen RJ, Shannon BA, Phillips M, Moorin RE, **Wheeler TM**, Garrett KL. Central zone

carcinoma of the prostate gland: a distinct tumor type with poor prognostic features. *J Urol*. 2008 May;179(5):1762-7; discussion 1767.

278. Hammerich KH, Hille S, Ayala GE, **Wheeler TM**, Engers R, Ackermann R, Mueller-Mattheis V. Malignant advanced granulosa cell tumor of the adult testis: case report and review of the literature. *Hum Pathol*. 2008 May;39(5):701-9.

279. Iczkowski KA, Hossain D, Torkko KC, Qian J, Lucia MS, **Wheeler TM**, Rewcastle JC, Bostwick DG. Preoperative Prediction of Unifocal, Unilateral, Margin-Negative, and Small Volume Prostate Cancer. *Urology*. 2008 Jun;71(6):1166-71.

280. Goldsmith JD, Siegal GP, Suster S, **Wheeler TM**, Brown RW. Reporting guidelines for clinical laboratory reports in surgical pathology. *Arch Pathol Lab Med*. 2008 Oct;132(10):1608-16.

281. Latour M, Amin MB, Billis A, Egevad L, Grignon DJ, Humphrey PA, Reuter VE, Sakr WA, Srigley JR, **Wheeler TM**, Yang XJ, Epstein JI. Grading of invasive cribriform carcinoma on prostate needle biopsy: an interobserver study among experts in genitourinary pathology. *Am J Surg Pathol*. 2008 Oct;32(10):1532-9.

282. Evans AJ, Henry PC, Van der Kwast TH, Tkachuk DC, Watson K, Lockwood GA, Fleshner NE, Cheung C, Belanger EC, Amin MB, Boccon-Gibod L, Bostwick DG, Egevad L, Epstein JI, Grignon DJ, Jones EC, Montironi R, Moussa M, Sweet JM, Trpkov K, **Wheeler TM**, Srigley JR. Interobserver variability between expert urologic pathologists for extraprostatic extension and surgical margin status in radical prostatectomy specimens. *Am J Surg Pathol*. 2008 Oct;32(10):1503-12.

283. Ayala G, Dai H, Powell M, Li R., Ding Y, **Wheeler TM**, Shine D, Kadmon D, Thompson TC, Miles BJ, Ittmann MM, Rowley D.: Cancer-related axonogenesis and neurogenesis in prostate cancer. *Clin Cancer Res*. 2008;14:7539-7603.

284. Sartor AO, Hricak H, **Wheeler TM**, Coleman J, Penson DF, Carroll PR, Rubin MA, Scardino PT. Evaluating localized prostate cancer and identifying candidates for focal therapy. *Urology*. 2008;72(6 Suppl):S12-24.

285. Ayala G, Yan J, Li R, Ding Y, Thompson TC, Mims MP, Hayes TG, MacDonnell V, Lynch RG, Frolov A, Miles BJ, **Wheeler TM**, Harper JW, Tsai MJ, Ittmann MM, Kadmon D. Bortezomib-mediated inhibition of steroid receptor coactivator-3 degradation leads to activated Akt. *Clin Cancer Res*. 2008 Nov 15;14(22):7511-8.

286. Rile Li, Hong Dai, Wheeler, TM, Mohammad S, Scardino P, Frolov A, Ayala G. High Level of Total AKT1 Predicts High Risk of Biochemical Recurrence and Prostate Cancer Sepcific Death. J Urol 2009 Jan ;181 (4) 775-775.

287. Weiss G, Cottrell S, Distler J, Schatz P, Kristiansen G, Ittmann M, Haefliger C, Lesche R, Hartmann A, Corman J, **Wheeler T**. DNA Methylation of the PITX2 Gene Promoter Region is a Strong Independent Prognostic Marker of Biochemical Recurrence in Patients with Prostate Cancer after Radical Prostatectomy. *J Urol*. Apr 2009;181(4):1678-85.

288. Weinreb JC, Blume JD, Coakley FV, **Wheeler TM**, Cormack JB, Sotto CK, Cho H,

Kawashima A, Tempany-Afdhal CM, Macura KJ, Rosen M, Gerst SR, Kurhanewicz J. Prostate cancer: sextant localization at MR imaging and MR spectroscopic imaging before prostatectomy--results of ACRIN prospective multi-institutional clinicopathologic study. *Radiology*. 2009 Apr;251(1):122-33.

289. Li R, Dai H, **Wheeler TM**, Sayeeduddin M, Scardino PT, Frolov A, Ayala GE. Prognostic value of Akt-1 in human prostate cancer: a computerized quantitative assessment with quantum dot technology. *Clin Cancer Res.* 2009 May 15;15(10):3568-73. Epub 2009 May 5.

290. Li R, Erdamar S, Dai H, Sayeeduddin M, Frolov A, **Wheeler TM**, Ayala GE. Cytoplasmic Accumulation of Glycogen Synthase Kinase-3β is Associated with Aggressive Clinicopathological Features in Human Prostate Cancer. *Anticancer Res*. 2009 Jun;29(6):2077-81.

291. Kelloff GJ, Choyke P, Coffey DS; Prostate Cancer Imaging Working Group. Challenges in clinical prostate cancer: role of imaging. *AJR Am J Roentgenol*. 2009 Jun;192(6):1455-70.

292. Srigley JR, Humphrey PA, Amin MB, Chang SS, Egevad L, Epstein JI, Grignon DJ, McKiernan JM, Montironi R, Renshaw AA, Reuter VE, **Wheeler TM**; Members of the Cancer Committee, College of American Pathologists. Protocol for the examination of specimens from patients with carcinoma of the prostate gland. *Arch Pathol Lab Med*. 2009 Oct;133(10):1568-76.

293. **Wheeler T**. Second opinions in pathology. *J Urol*. 2010 Mar;183(3):850-1.

294. Hammond ME, Hayes DF, Dowsett M, Allred DC, Hagerty KL, Badve S, Fitzgibbons PL, Francis G, Goldstein NS, Hayes M, Hicks DG, Lester S, Love R, Mangu PB, McShane L, Miller K, Osborne CK, Paik S, Perlmutter J, Rhodes A, Sasano H, Schwartz JN, Sweep FC, Taube S, Torlakovic EE, Valenstein P, Viale G, Visscher D, **Wheeler T**, Williams RB, Wittliff JL, Wolff AC. American Society of Clinical Oncology/College Of American Pathologists guideline recommendations for immunohistochemical testing of estrogen and progesterone receptors in breast cancer. *J Clin Oncol*. 2010 Jun 1;28(16):2784-95. Epub 2010 Apr 19.

295. McGuire AL, Majumder MA, Halpern SD, Swindell JS, Yaeger LV, Gibbs RA, **Wheeler TM**. Taking DNA from the dead. *Nat Rev Genet.* 2010 Mar 23. [Epub ahead of print]

296. Bañez LL, Sun L, Leenders GJ, **Wheeler TM**, Bangma CH, Freedland SJ, Ittmann MM, Lark AL, Madden JF, Hartman A, Weiss G, Castaños-Vélez E. Multicenter Clinical Validation of PITX2 Methylation as a Prostate Specific Antigen Recurrence Predictor in Patients With Post-Radical Prostatectomy Prostate Cancer. *J Urol*. 2010 May 15. [Epub ahead of print]

297. Hammond ME, Hayes DF, Dowsett M, Allred DC, Hagerty KL, Badve S, Fitzgibbons PL, Francis G, Goldstein NS, Hayes M, Hicks DG, Lester S, Love R, Mangu PB, McShane L, Miller K, Osborne CK, Paik S, Perlmutter J, Rhodes A, Sasano H, Schwartz JN, Sweep FC, Taube S, Torlakovic EE, Valenstein P, Viale G, Visscher D, **Wheeler T**, Williams RB, Wittliff JL, Wolff AC. American Society of Clinical Oncology/College of American Pathologists guideline recommendations for immunohistochemical testing of estrogen and progesterone receptors in breast cancer. *Arch Pathol Lab Med*. 2010 Jun; 134(6):907-22.

298. O'Brien BA, Cohen RJ, **Wheeler TM**, Moorin RE. A post-radical-prostatectomy nomogram incorporating new pathological variables and interaction terms for improved prognosis. *BJU Int*. 2010 Jul.

299. Hall CA, Wang R, Miao J, Oliva E, Shen X, **Wheeler T**, Hilsenbeck SG, Orsulic S, Goode S. Hippo Pathway Effector Yap Is An Ovarian Cancer Oncogene. *Cancer Res*. 2010 Nov 1;70(21):8517-25.

300. Ayala GE, Muezzinoglu B, Hammerich KH, Frolov A, Liu H, Scardino PT, Li R, Sayeeduddin M, Ittmann MM, Kadmon D, Miles BJ, **Wheeler TM**, Rowley DR. Determining prostate cancer-specific death through quantification of stromogenic carcinoma area in prostatectomy specimens. *Am J Pathol*, 2011 Jan 178(1) 79-87.

301. Samaratunga H, Montironi R, True L, Epstein JI, Griffiths DF, Humphrey PA, van der Kwast T, **Wheeler TM**, Srigley JR, Delahunt B, Egevad L; ISUP Prostate Cancer Group. International Society of Urological Pathology (ISUP) Consensus Conference on Handling and Staging of Radical Prostatectomy Specimens. Working Group 1: Specimen Handling. *Mod Pathol*. 2011 Jan;24(1):6-15. doi: 10.1038/modpathol.2010.178. Epub 2010 Sep 10. Review.

302. Berney DM, **Wheeler TM**, Grignon DJ, Epstein JI, Griffiths DF, Humphrey PA, van der Kwast T, Montironi R, Delahunt B, Egevad L, Srigley JR; ISUP Prostate Cancer Group. International Society of Urological Pathology (ISUP) Consensus Conference on Handling and Staging of Radical Prostatectomy Specimens. Working Group 4: Seminal Vesicles and Lymph Nodes. *Mod Pathol*. 2011 Jan;24(1):39-47. doi: 10.1038/modpathol.2010.160. Epub 2010 Sep 3. Review.

303. van der Kwast TH, Amin MB, Billis A, Epstein JI, Griffiths D, Humphrey PA, Montironi R, **Wheeler TM**, Srigley JR, Egevad L, Delahunt B; ISUP Prostate Cancer Group. International Society of Urological Pathology (ISUP) Consensus Conference on Handling and Staging of Radical Prostatectomy Specimens. Working Group 2: T2 Substaging and Prostate Cancer Volume. *Mod Pathol*. 2011 Jan;24(1):16-25. doi: 10.1038/modpathol.2010.156. Epub 2010 Sep 3. Review.

304. Magi-Galluzzi C, Evans AJ, Delahunt B, Epstein JI, Griffiths DF, van der Kwast TH, Montironi R, **Wheeler TM**, Srigley JR, Egevad LL, Humphrey PA; ISUP Prostate Cancer Group. International Society of Urological Pathology (ISUP) Consensus Conference on Handling and Staging of Radical Prostatectomy Specimens. Working Group 3: Extraprostatic Extension, Lymphovascular Invasion and Locally Advanced Disease. *Mod Pathol*. 2011 Jan;24(1):26-38. doi: 10.1038/modpathol.2010.158. Epub 2010 Aug 27. Review.

305. Tan PH, Cheng L, Srigley JR, Griffiths D, Humphrey PA, van der Kwast TH, Montironi R, **Wheeler TM**, Delahunt B, Egevad L, Epstein JI; ISUP Prostate Cancer Group. International Society of Urological Pathology (ISUP) Consensus Conference on Handling and Staging of Radical Prostatectomy Specimens. Working Group 5: Surgical Margins. *Mod Pathol*. 2011 Jan;24(1):48-57. doi: 10.1038/modpathol.2010.155. Epub 2010 Aug 20.

306. The BS, Ishiyama H, Xu B, Ayala G, **Wheeler T**, Kadmon D, Paulino A.C., Blanco A.I., Thompson T, Butler E. Long-term Outcome of a Phase II Trial Combining in Situ Gene Therapy and Intensity Modulated Radiotherapy With or Without Hormonal Therapy for Prostate Cancer. Fuel and Energy Abstracts 01/2011; 81(2)

307. Cohen RJ, O'Brien BA, **Wheeler TM.** Ductal adenocarcinoma of the prostate. *Hum Pathol*. 2011 April; 42 (4):605-6.

308. Cohen RJ, O'Brien BA, **Wheeler TM.** Desquamating apoptotic variant of high-grade prostatic intraepithelial neoplasia: a possible precursor of intraductal prostatic carcinoma. *Hum Pathol*. 2011 Jun; 42 (6): 892-5.

309. Mouraviev V, Villers A, Bostwick DG, **Wheeler TM,** Montironi R, Polascik TJ. Understanding the pathological features of focality, grade and tumour volume of early stage prostate cancer as a foundation for parenchyma-sparing prostate cancer therapies: active surveillance and focal targeted therapy. *BJU Int*. 2011 Oct; 108 (7) 1074-85.

310. IczkowskiKA, Torkko KC, Kotnis GR, Wilson RS, Huang W, **Wheeler TM**, Abeyta AM, La Rosa FG, Cook S, Wereahera PH, Lucia MS. Digital quantification of five high-grade prostate cancer patterns, including the cribriform pattern and their association with adverse outcome . *Am J. Clin Pathol*. 2011 Jul; 136 (1): 98 – 107.

311. Sonpavde G, Thompson TC, Jain RK, Ayala GE , Kurosaka S, Edamura K, Tabata K, Ren C, Goltsov AA, Mims MP, Hayes TG, Ittmann MM**, Wheeler TM**, Gee A, Miles BJ, Kadmon D. GLIPR1 tumor suppressor gene expressed by adenoviral vector as neoadjuvant intraprostatic injection for localized intermediate or high-risk prostate cancer preceding radical prostatectomy. *Clin Cancer Res*. 2011 Nov 12; 17 (22): 7174 – 82.

312. Iczkowski KA, Torkko KC, Kotnis GR, Wilson RS, Huang W, **Wheeler TM**, Abeyta AM, Lucia MS. Pseudolumen size and perimeter in prostate cancer: correlation with patient outcome. *Prostate Cancer*. 2011 Epub 2011 Jul 14

313. Wilt TJ, Brawer MK, Jones KM, Barry MJ, Aronson WJ, Fox S, Gingrich JR, Wei JT, Gilhooly P, Grob BM, Nsouli I, Iyer P, Cartagena R, Snider G, Roehrborn C, Sharifi R, Blank W, Pandya P, Andriole GL, Culkin D, **Wheeler TM,** for the Prostate Cancer Intervention versus Observation Trial (PIVOT) Study Group. Radical Prostatectomy versus Observation for Localized Prostate Cancer. *NEJM*. 2012 July; 367 (3): 204-213.

314. Ross HM, Kryvenko ON, Cowan JE, Simko JP, **Wheeler, TM**, Epstein JI. Do Adenocarcinomas of the Prostate With Gleason Score (CS) ≤ 6 Have the Potential to Metastasize to Lymph Nodes? *Am J. Surg Pathol*. 2012 Sept; 36 (9): 1346-1352

315. Kench, JF, Delahunt B, Griffiths, DF, Humphrey PA, McGowan T, Trpkov K, Varma M, **Wheeler TM**, Srigley JR. Dataset for reporting of prostate carcinoma in radical prostatectomy specimens: recommendations from the International Collaboration on Cancer Reporting. *Histopathology*, 2013 Jan: 62 (2) :203-18

316. Bonkhoff H, **Wheeler TM**, van der Kwast TH, Magi-Galluzzi C, Montironi R, Cohen RJ. Intraductalcarcinoma of the prostate: precursor or aggressive phenotype of prostate cancer? *Prostate*. 2013 Mar;73(4):442-8

317. Dietrich D, Hasinger O, Banez, LL, Sun L, van Lenders GJ, **Wheeler TM**, Bangma CH, Wernert N, Perner S, Freedland SJ, Corman JM, Ittmann MM, Lark AL, Madden JF, Hartmann A, Schatz P. Development and Clinical Validation of a Real-Time PCR Assay for PITX2 DNA Methylation to Predict Prostate-Specific Antigen Recurrence in Prostate Cancer Patients Following Radical Prostatectomy. J. Mol Diagn. 2013 Mar;15 (2)270-9

318. Sonpavde G, Wang M, Peterson LE, Wang HY, Joe T, Mims MP, Kadmon D, Ittmann MM, **Wheeler, TM**, Gee AP, Wang RF, Hayes TG. HLA-restricted NY-ESO-1peptide immunotherapy for metastatic castration resistant prostate cancer. Invest New Drugs. 2013 Apr 23(Epub ahead of print)

319. Bjurlin MA, Carter HB, Schellhammer P, Cookson MS, Gomella LG, Troyer D, **Wheeler TM,** Schlossberg S, Penson DF, Taneja SS. Optimization of initial prostate biopsy in clinical practice; sampling, labeling and specimen processing. *J Urol* 2013; June 189(6):2039-46

320. Comperat E, Camparo P, Srigley J, Delahunt B, Egevad L; **ISUP Consensus Working Group**. Internation Society of Urological Pathology (ISUP) Consensus Conference on handling and staging of radical prostatectomy specimens. *Ann Pathol*. 2013 June;33(3):155 - 61.

321. McDunn JE, Li Z, Adam KP, Neri BP, Wolfert RL, Milburn MV, Lotan Y, **Wheeler TM.** Metabolomic signatures of aggressive prostate cancer. *Prostate*. 2013 October; (33): 1547 1560.

322. San Martin R, Barron DA, Tuxhorn JA, Ressler SJ, Hayward SW, Shen X, Laucirica R, **Wheeler TM,** Gutierrez C, Ayala GE, Ittmann M, Rowley DR. Recruitment of CD34(+) fibroblasts in tumor-associated reactive stroma: the reactive microvasculature hypothesis. Am J Pathol. 2014; 184(6) 1860-70

323. Amin MB, Lin DW, Gore JL, Srigley JR, Samaratunga H, Egevad L, Rubin M, Nacey J, Carter HB, Klotz L, Sandler H, Zietman AL, Holden S, Montironi R, Humphrey PA, Evans AJ, Delahunt B, McKenney JK, Berney D**, Wheeler TM**, Chinnaiyan AM, True L, Knudsen B, Hammond E. The Critical Role of the Pathologist in Determining Eligibility for Active Surveillance as a Management Option in Patients with Prostate Cancer: Consensus Statement With Recommendations Supported by the College of American Pathologists, International Society of Urological Pathology, Association of Directors of Anatomic and Surgical Pathology, the New Zealand Society of Pathologists and the Prostate Cancer Foundation. Arch Pathol Lab Med. August 5, 2014.

324. Iczkowski KA, Egevad L, Ma J, Harding-Jackson N, Algaba F, Billis A, Camparo P, Cheng L, Clouston D, Comperat EM, Datta MW, Evans AG, Griffiths DF, Guo CC, Hailemariam S, Huang W, Humphrey PA, Jiang Z, Kahane H, Kristiansen G, La Rosa FG, Lopez-Beltran A, MacLennan GT, Magi-Galluzzi C, Merrimen J, Montironi R, Osunkoya AO, Picken MM, Rao N, Shah RB, Shanks JH, Shen SS, Tawfik OW, True LD, Van der Kwast T, Varma M, **Wheeler TM**, Zynger DL, Sahr N, Bostwick DG. Intraductal carcinoma of the prostate: interobserver reproducibility survey of 39 urologic pathologists. Ann Diagn Pathol. 2014 Dec;18(6):333-42. Doi 10.1016/j.anndiagpath.2014.08.010. Epub 2014 Sep 3.

325. Oluyemisi AA, Edwards C, **Wheeler TM**, Hawkins SM. Abdominal Wall Emdometriosis as Endometrioma-Cutaneous Fistula: A Case Report. Open Journal of Obstetrics and Gynecology; Sep 2014

326. Delahunt B, Hammond E, Egevad L, Samaratunga H, Srigley JR, Humphrey PA, Rubin M, Epstein JI, Lin DW, Gore JL, Nacey JN, Klotz L, Sandler H, Zietman AL, Holden S, Montironi R, Evans AJ, McKenney JK, Berney D, **Wheeler TM**,

Chinnaiyan AM, True L, Knudsen B, Amin MB. Active surveillance for prostate cancer: the role of the pathologist. Pathology. 2015 Jan;47(1):1-3. doi: 10.1097/PAT.0000000000000186. No abstract available.

327. Von Rundstedt FC, Lerner SP, Godoy G, Arniel G**, Wheeler TM**, Truong LD, Shen SS. Usefulness of transurethral biopsy for staging the prostatic urethra before radical cystectomy. J Urol 2015 Jan; 193

328. Epstein JI, Egevad L, Amin MB, Delahunt B, Srigley JR, Humphrey PA, ;**Grading Committee**. The 2014 International Society of Urological Pathology (ISUP) Consensus Conference on Gleason Grading of Prostatic Carcinoma: Definition of Grading Patterns and Proposal for a New Grading System. Am J Surg Pathol. 2016 Feb; 40(2):244 – 52.

329. Han RI, **Wheeler TM**, Lumsden AB, Reardon MJ, Lawrie GM, Grande-Allen KJ, Morrisett JD, Brunner G. Morphometric analysis of calcification and fibrous layer thickness in carotid endarterectomy tissues. Comput Biol Med. 2016 Mar 1;70:210-9

330. Wang DH, Lee HS, Yoon D, Berry G, **Wheeler TM**, Sugarbaker DJ, Kheradmand F, Engleman EG, Burt BM. Progression of EGFR mutant lung adenocarcinoma is driven by alveolar macrophages. Clin Cancer Res. 2016 Aug 5

BOOK CHAPTERS:

1. Coburn M, **Wheeler TM**: Testicular biopsy in male infertility evaluation. In: *Infertility in the Male.* Edited by Lipshultz LI, Howards SS, Chicago: Mosby-Year Book, Inc., 223, 1991.

2. Coburn M, **Wheeler TM**: Evaluation of testicular biopsy in male infertility evaluation. In: *Infertility in the Male.* 2nd ed., Edited by Lipshultz LI, Howards S.S., St. Louis, MO: Year Book Medical Publishers, 1992.

3. **Wheeler TM**: Anatomy of the prostate and pathology of prostate cancer. In: *Comprehensive Textbook of Genitourinary Oncology.* Edited by Vogelzang NJ, Scardino PT, Shipley WU, Coffey DS, Baltimore: Williams & Wilkins, 1996, pp. 621-639.

4. Schwartz MR, **Wheeler TM**, Ramzy I: Cytopathology of endocrine organs. In: *Bloodworth's Endocrine Pathology*. 3rd Edition, Edited by Lechago J, Gould VE, Baltimore: Williams & Wilkins, 1996.

5. Laucirica R, Lechago J, **Wheeler TM**: Endocrine aspects of the male reproductive system. In: *Bloodworth's Endocrine Pathology*. 3rd ed., Edited by Lechago J, Gould VE, Baltimore: Williams & Wilkins, 1996.

6. Scardino PT, **Wheeler TM**, Kattan MW: Is cure for prostate cancer possible in those for whom it is necessary? In: *Renal, bladder, and prostate cancer an update* [The proceedings of the V Congress on Progress and Controversies in Oncological Urology (PACIOU V), held in Rotterdam, The Netherlands, October 1998], Edited by Kurth KH, Mickisch GH, Schoöder FH; The Parthenon Publishing Group, New York, 1999.

7. **Wheeler TM**: 36A. Anatomy of the Prostate and the Pathology of Prostate Cancer, In: *Comprehensive Textbook of Genitourinary Oncology*, Part V. Prostate Cancer, Section 36 Anatomy and Pathology of Prostate Cancer, Edited by Vogelzang NJ, Scardino PT, Shipley WU, Coffey DS, Philadelphia: Lippincott, Williams & Wilkins, 2nd Edition, 2000, pp. 587 - 604.

8. Ayala G and **TM Wheeler**. Anatomy of the Prostate and Pathology of Prostate Cancer, In: *Comprehensive Textbook of Genitourinary Oncology*, Part V. Prostate Cancer, Section 6 Anatomy and Pathology of Prostate Cancer, Edited by Vogelzang NJ, Scardino PT, Shipley WU, Debruyne FMJ, Linehan WM. Philadelphia: Lippincott, Williams & Wilkins, 3rd Edition, 2005, pp. 45-59.

9. Timme TL, Fujita T, Wang H, Naruishi K, Kadmon D, Amato RJ, Miles BJ, Ayala G, **Wheeler TM**, Teh BS, Butler EB, Thompson TC. Cytokine gene therapy for genitourinary cancer. In: *Gene Therapy for Cancer*. Hunt KK and Vorburger SA, eds, Humana Press, in press 2005.

10. Alukal JP, Khear M, **Wheeler TM**: Testicular biopsy in male infertility evaluation. In: *Infertility in the Male*. 4th ed., Edited by Lipshultz LI, Howards SS, Niederberger CG., Cambridge: Cambridge University Press, 2009.

11. Vladimir Mouraviev, **Thomas Wheeler**, and Thomas J. Polascik: Histological Trends and the Index Lesion in Localized Prostate Cancer. In: *Focal Therapy in Prostate Cancer*. Wiley and Sons Ltd: 2011

12. Olar A, **Wheeler TM**: Atypical Small Acinar Proliferation. In: *Prostate Cancer Diagnosis*. Springer: 2013

13. Lockyer M, **Wheeler TM:** Prostate cancer: Screening, surveillance, prognostic algorithms and independent pathologic predictive parameter. In: *Cancer Expert: Clinical Perspective.* John Wiley and Sons, Inc. 2014

INVITED LECTURES, PANEL MEMBER, VISITING PROFESSORSHIPS:

1. <u>Fine Needle Aspiration of Prostate</u>, presented at the Spring Meeting of the Texas Society of Cytology, 1984.

2. <u>New Concepts and Methods in the Pathology of Prostatic Carcinoma</u>, presented at Innovative Approaches to Urologic Problems, Houston, Texas, 1985.

3. <u>Endocrine Pathology</u>, presented at Pathology Board Review Course, Houston, Texas, 1986.

4. <u>What to Expect From the Pathologist in the Evaluation of Bladder Cancer</u>, presented at Innovations in Urologic Practice, Houston, Texas, 1986.

5. <u>Fine Needle Aspiration Cytology of Breast and Prostate</u>, presented at the Annual Cytopathology Review Course, Houston, Texas, 1987-1990.

6. <u>Anatomy of the Prostate and the Biology of Prostate Cancer</u>, presented at the American Urological Association sponsored meeting, *Ultrasound in Urology*, Houston, Texas, 1988.

7. Pathology and Patterns of Growth of Prostate Cancer: Information Gained From Whole-Mount Step Sections of the Prostate, presented at Transrectal Ultrasonography for Prostate Cancer, Houston, Texas, 1988.

8. Anatomy of the Prostate, Pathology and Patterns of Growth of Prostate Cancer, presented at Transrectal Ultrasonography of the Prostate, Houston, Texas, 1989.

9. New Concepts in the Pathology of Prostate Cancer, presented at Innovations in Urologic Practice, Houston, Texas, 1989.

10. What to Expect From the Pathologist's Report, presented at the Section on Bladder Cancer at Innovations in Urologic Practice, Houston, Texas, 1989.

11. Pathologic Features of Testicular Cancer and Carcinoma *In Situ*, presented at Innovations in Urologic Practice, Houston, Texas, 1989.

12. Fine Needle Aspiration of Prostate, presented at the Osler Cytopathology Board Review Course, Dallas, Texas, 1990.

13. Fine Needle Aspiration Cytology of Thyroid, presented at the Annual Cytopathology Review Course, Houston, Texas, 1986-1996.

14. Radical Prostatectomy: The Baylor Experience, presented at the Houston Society of Clinical Pathologists Annual Seminar, Houston, Texas, 1994.

15. Anatomic Considerations in Carcinoma of the Prostate, presented at the monthly meeting of the Houston Society of Clinical Pathologists, 1994.

16. Thyroid Fine Needle Aspiration Biopsy, presented at the monthly meeting of the Houston Society of Clinical Pathologists, 1995.

17. Visiting Professor, Baylor University Medical Center, Dallas, Texas 1993.

18. Participant/Speaker, Quantitative Pathology in Chemoprevention Trials: Standardization and Quality Control of Surrogate Endpoint Biomarker Assays for Colon, Breast and Prostate (NCI), San Diego, California, 1994.

19. Participant/Speaker, Prognostic Markers in Prostate Cancer (College of American Pathologists) Snowmass, Utah 1995.

20. Visiting Professor, Long Island Jewish Hospital, 1995.

21. Management of Carcinoma of the Prostate: Pros and Cons of Current modalities and New Paradigms.

22. Participant/Speaker, International Consultation on Prostatic Intraepithelial Neoplasia and Pathologic Staging of Prostate Cancer, Rochester, MN, November 1995.

23. Visiting Professor, Semipalatinsk Medical Institute and Affiliated Hospitals, Semipalatinsk, Kazakhstan, 1995, 1996.

24. Visiting Professor, American Hospital, Istanbul, Turkey, November 1996.

25. Visiting Professor, Baskent University Hospital, Ankara, Turkey, November 1996.

26. Mimics of Prostate Cancer, presented at the Texas Society of Pathologists Annual Meeting in Corpus Christi, Texas, January 1997.

27. Visiting Professor, University of Massachusetts Medical Center, Worcester, MA, March 1997.

28. Participant/Speaker, Annual Review Course, Wilford Hall USAF Medical Center, Lackland AFB, Texas, May 1998.

29. Thyroid FNA: Thyroid FNA, Value & Diagnostic Limitations, presented at the Section on Pathology at the Texas Medical Association 130th Annual Session, Houston, Texas, May 1998.

30. Contemporary Cytology and Histopathology of the Thyroid, presented at the Update on Medical and Surgical Management of Thyroid Disease, Houston, Texas, June 1998.

31. Morphological Issues in Prostate Cancer and Their Effect in Prognosis, presented at the International Academy of Pathologists, 24th Annual Scientific Meeting, Sydney, Australia, June 1998.

32. Significance of Gleason Grading and Prostate-Specific Antigen, presented at the Management of Carcinoma of the Prostate: Pros and Cons of Current Modalities and New Paradigms, Long Beach, California, July 23–24, 1998.

33. Morphologic Features in Prostate Carcinoma and Their Effects on Prognosis, presented at Texas Society of Pathologists, Young Pathologists' Retreat, Galveston, Texas, August 1999.

34. Treatment Effects on Prostate Cancer and PIN, presented at the Japanese Urological Association annual meeting in Sapporo, Japan, June 2000.

35. Mimics of Prostate Cancer, presented at Kitasato University, Japan, June 2000.

36. Annual Broder's lecturer at Scott & White Clinic, Temple, TX, September 2000.

37. Morphological determinants of Prostate Cancer Prognosis, Texas Society of Pathologists Annual meeting, Houston, TX 2003.

38. Radical Prostatectomy presented at the USCAP Long Course, Washington, D.C., 2003.

39. The Complex Pathology of Human Prostate Cancer, Therapeutic Targeting of Human Prostate Cancer, Tucson, AZ, 2004.

40. Visiting Professor, University of Arizona, Tucson, AZ, Spring 2004.

41. International Society of Urological Pathology Panelist on Gleason Grading at USCAP, Feb. 2005.

42. Prognostic aspects of the morphological features of prostate cancer, Grand Rounds Guest Lecturer, University of Texas-Health Science Center, Houston, TX, May 2005.

43. Biospecimen Collection, Processing and Storage, Quality Assurance, Quality Control, and Operational Issues Including Bioinformatics Workshop, Invited Participant, National Cancer Institute, Washington, DC, July 2005.

44. Panel Moderator, Genitourinary Pathology Proffered Papers at the USCAP, Feb. 2006.

45. “Brain Trust” on Prostate Cancer Imaging, Panel Moderator, Pathology Section, AdMeTech Corporation, Bethesda, MD, March 2006.

46. Visiting Professor, University of Southwestern Medical Center, Dallas, TX, March 2006.

47. Morphological Features of Prostate Cancer and Effects on Prognosis, presented at North Texas Society of Pathologists meeting, Dallas, TX, March 2006.

48. ASCO/CAP Technology Assessment on HER2 Testing, Panel Member, ASCO, Alexandria, VA, March 2006.

49. Micropapillary and Small Cell Cancer – Rare Variants or Variations on a TCC Theme?, presented at 14th Innovations in Urologic Practice, BCM, Santa Fe, NM, September 2006.

50. Introduction to Prostate Anatomy and Disease States (Benign and Malignant), presented at 2006 Annual Society for Basic Urologic Research meeting, Phoenix, AZ, November 2006.

51. New Vistas in Pathology, presented at TX US TOO Prostate Cancer Group Monthly Meeting, Houston, TX, January 2007.

52. Issue in Anatomic Pathology Reporting, Keynote Speaker at PowerPath Users Group Meeting, San Diego, CA, May 2007.

53. Focal Therapy: The Pathologist’s Perspective, presented at the First International Workshop on Focal Therapy and Imaging of Prostate Cancer, Durham, NC, February 2008.

54. What are the Pathological Features of Low Risk Cancer Suitable for Focal Therapy?, presented at the Society of Urologic Oncology Annual meeting, Bethesda, MD, December 2008.

55. Consensus Conference on Prostate Imaging, speaker and moderator at AdMeTech meeting, Bethesda, MD, January 2009.

56. Clinical Pathologic Associations in Prostate Cancer, presented at Baylor College of Medicine, Department of Surgery Grand Rounds, Houston, TX, January 2010.

57. Getting That First Job, presented at Texas Society of Pathology Annual Meeting, Galveston, TX, January 2010.

58. Clinical Pathologic Associations in Prostate Cancer, presented at TX US TOO Prostate Cancer Group Monthly Meeting, Houston, TX, February 2010.

59. Pathologic Basis for Unifocal and Unilateral Prostate Cancer, presented at Third International Symposium on Focal Therapy and Imaging of Prostate and Kidney Cancer, Washington, DC, February 2010.

60. The Visible Pathologist , presented at CAP ’12- The Pathologist’s Meeting, San Diego, CA, September 2012. CAP’ 13- The Pathologist’s Meeting, Orlando, FL, October 2013. CAP ’14- The Pathologist’s Meeting, Chicago, IL, September 2014.

61. Prostate Anatomy, Benign Conditions; Precursors and Mimics of Cancer, presented at the International Pathology Symposium, Riyadh, Saudi Arabia, November 2012.

62. Prostate Cancer – Diagnosis, Grading, Staging and Important Variants, presented at the International Pathology Symposium, Riyadh, Saudi Arabia, November 2012.

63. Prostate Cancer – The role of the Pathologist, presented at CAP AP3 program in Prostate Pathology, Chicago, Illinois, April 2014

64. Important Issues in Prostate Cancer Pathology, presented at the Department of Pathology Grand Rounds- Medical College of Georgia, Augusta, Georgia, June 2016

Exhibit E

August 14, 2020

Daniel Adams
Larson King, LLP
30 East Seventh Street
St. Paul, Minnesota 55101

Subject: Expert Report in the matter of *James LaFrentz and Ila LaFrentz v. 3M Company, et al. (regarding 3M Company)*

Dear Mr. Adams:

I have prepared the attached report in response to the request for my retention in the James LaFrentz matter made on August 5, 2020. The first set of case materials was received for my review on August 5, 2020.

It is my understanding that I have been retained by counsel on behalf of 3M to offer my opinions concerning the regulatory standards and requirements over time related to respirator use, as well as respirator use with asbestos, employer responsibility, Mr. LaFrentz's asbestos exposure potential, and the historical evolution of knowledge of industrial hygienists regarding asbestos.

My opinions are reflected in the attached report. I have also provided a brief description of my background and areas of expertise relating to this matter, including a discussion of my knowledge and experience in the field of industrial hygiene.

Respectfully,

Jennifer Sahmel, MPH, CIH, CSP, FAIHA
Managing Principal Scientist

Attachments

Expert Report of
Jennifer Sahmel, MPH, CIH, CSP, FAIHA

Expert Report in the matter of *James LaFrentz and Ila LaFrentz v. 3M Company, et al. (regarding 3M Company)*

Prepared for:

Daniel Adams
Larson King, LLP
30 East Seventh Street
St. Paul, Minnesota 55101

Prepared by:

Jennifer Sahmel
Insight Exposure and Risk Sciences
1790 38th Street, Suite 100
Boulder, CO 80301

August 14, 2020

I. EXPERIENCE

I am a Certified Industrial Hygienist (CIH) [American Board of Industrial Hygiene (ABIH)] and a Certified Safety Professional (CSP) [Board of Certified Safety Professionals (BCSP)] with over 23 years of experience in human health exposure, risk assessment, and workplace health and safety. I am also a Fellow of the American Industrial Hygiene Association (FAIHA) and a Research Fellow of the Exposure Science and Sustainability Institute at the University of Minnesota. I have experience in exposure assessment methodologies, the history and state of the science for industrial hygiene over time, health risk decision making, exposure monitoring, and safety management systems. I have conducted chemical-specific exposure assessments for a wide range of substances, including asbestos, acrylamide, benzene, carbon monoxide, silica, diesel exhaust, solvents, vinyl chloride, phthalates, talc, lead, and cadmium.

In my current position, I am a Managing Principal Scientist of Insight Exposure and Risk Sciences. Insight is dedicated to addressing scientifically complex and technical questions related to human health and safety, including exposure and risk assessment. I specialize in the disciplines of industrial hygiene, exposure science, occupational and consumer exposure assessment, and exposure reconstruction. This includes but is not limited to dermal, inhalation, and ingestion exposure potential to agents found in consumer products, the ambient air, industrial materials and other media.

My publications include a comprehensive review paper on exposure reconstruction methods for human health risk assessment (Sahmel et al. 2010), as well as a review of the history and evolution of knowledge of industrial hygienists regarding asbestos (Barlow et al. 2017). I have specifically published on the topics of asbestos bystander and take home exposure potential, fiber settling, and the epidemiology of background exposures (Donovan et al. 2011; Sahmel et al. 2014a; Sahmel et al. 2016; Sahmel et al. 2015a; Glynn et al. 2018). I have also published papers addressing the use of industrial hygiene principles, exposure assessment, and exposure reconstruction for vinyl chloride, benzene, carbon monoxide, talc, lead, and a number of other chemicals (Paustenbach et al. 2010; Sahmel et al. 2009b; Williams et al. 2011; Sahmel et al. 2014b; Sahmel et al. 2015c; Avens et al. 2018; Burns et al. 2019).

I am active in the industrial hygiene scientific community in the United States and internationally, and have served on both International Standards Organization (ISO) and American National Standards Institute (ANSI) committees, including the ANSI Z88 Committee between 2000 and 2017. I was elected to the American Industrial Hygiene Association's (AIHA's) Board of Directors

for 2014-2017. I am also a past Chair of the AIHA's Exposure Assessment Strategies Committee, and the founder of the committee's working group on dermal exposure assessment. I am a co-author for the committee's text on exposure assessment strategies (Ignacio et al. 2006; Sahmel et al. 2006a; Sahmel et al. 2006b; Sahmel et al. 2015b; Boeniger et al. 2015) and the committee's occupational exposure mathematical modeling textbook (Keil et al. 2009; Sahmel et al. 2009a). Additionally, I have been an instructor for multiple professional development courses on exposure assessment for the AIHA's annual conference (AIHCE) for the past nine years, including the topics of exposure assessment strategies, exposure assessment modeling, dermal exposure assessment, and professional judgment in exposure assessment. I was also an instructor for the committee's Exposure Assessment Symposia in 2003, 2005, and 2009.

I have been invited to give presentations and workshops on exposure assessment at NASA's annual Occupational Health Conference, the Navy and Marine Corps Public Health Conference, the China-U.S. Occupational Health Symposium, the National Institute for Occupational Safety and Health, the Colombian Society for Occupational Hygiene, the California Industrial Hygiene Council (CIHC), and multiple local geographic chapters of the AIHA. I am a current Co-Chair of the NIOSH-facilitated National Occupational Research Agenda (NORA) Cross-Sector Council for Immune, Infectious, and Dermal Disease. NORA is a partnership program to stimulate innovative research and improved workplace practices, in which diverse parties collaborate to identify the most critical issues in workplace safety and health and then make progress on those issues through information sharing, collaboration, and enhancing dissemination and implementation of evidence-based practices. I was also a member of the NIOSH Expert Workgroup on Skin Notations and Dermal Exposure Issues (2005-2009), which was charged with assisting the agency in updating and expanding the NIOSH skin notations and provided expert guidance to NIOSH on dermal exposure issues.

While working in the U.S. EPA's Office of Pollution Prevention and Toxics (OPPT) in their Chemical Engineering Branch, I reviewed and contributed to occupational health and exposure assessment research and standards for the management of numerous national programs including the Toxics Substances Control Act, the Pollution Prevention program, Green Engineering, Design for the Environment, National Program Chemicals, Voluntary Children's Chemical Evaluation Program (VCCEP), and counter-terrorism activities. I worked with numerous EPA risk assessment models to evaluate a wide variety of exposure scenarios.

My professional education, training, and background are consistent with the topics and areas of scientific study about which I will testify. My curriculum vitae, which presents my background and training, is included as Attachment A to this report.

II. MATERIALS REVIEWED IN FORMULATING OPINIONS

My opinions are based on my professional qualifications, work experiences, and knowledge of industrial hygiene, exposure assessment, and related fields. My views are also based on information that is related to this case. In the process of preparing this report, I have received the following case-specific documents:

1. Plaintiffs' Second Amended Complaint
2. Deposition transcript of James LaFrentz, dated November 14, 2018
3. Deposition transcript of James LaFrentz, dated November 15, 2018
    a. Exhibits to the depositions of James LaFrentz
4. Plaintiffs' Third Supplemental Rule 26(A) Disclosure
5. Expert Report of Darell Bevis
6. Expert Report of Ken Garza

I have also reviewed and relied upon published papers, reports, regulatory materials and textbooks on industrial hygiene, toxicology, medicine, and standard practices associated with asbestos use available in the open literature. Specific references cited in my opinions are listed at the end of this report.

My opinions and the basis for these opinions are provided in Sections IV and V of this report. I express these to a reasonable degree of scientific certainty. It is my understanding that discovery is ongoing in this matter, and therefore I reserve the right to supplement this report in the event that additional information becomes available. My time spent in the preparation of this opinion letter and reviewing documents to formulate my opinions as well as for any deposition or trial testimony I may be called upon to give will be billed at a rate of $395 per hour.

III. CASE-SPECIFIC INFORMATION

General Case Summary

Mr. James Benjamin LaFrentz was born on November 24, 1944, and was reportedly diagnosed with mesothelioma in June 2018, at the age of 73 (LaFrentz Vol. I: p. 24). He reported that he had previously been diagnosed with kidney cancer in 1994 (LaFrentz Vol. 2: p. 11). He testified that he began smoking when he was 15 or 16, and recalled smoking “mainly Marlboro” brand cigarettes (LaFrentz Vol. I: p. 146, l. 18). He indicated that he smoked one or two cigarettes per day in high school, and then as an adult smoked “maybe a pack a day” of Marlboro Reds or Marlboro Lights; he never recalled smoking Kent cigarettes (LaFrentz Vol. I: p. 147, l. 21; p. 148).

Mr. LaFrentz testified that he was a member of the International Association of Machinist and Aerospace Workers while employed as a machinist at General Dynamics (LaFrentz Vol. I: p. 165). He also believed that he “had to be a member of some kind of steamfitters union while [he] worked” one summer as an apprentice (LaFrentz Vol. I: p. 166). He did not recall ever receiving any education or warnings from the steamfitters union regarding the hazards of asbestos (LaFrentz Vol. I: p. 175).

Mr. LaFrentz was not aware of any claims that had been submitted to bankruptcy trusts (LaFrentz Vol. I: p. 192-193).

Summer Employment During High School (summers from 1960 or 1961 to 1963)

Mr. LaFrentz testified that he worked in the summers during high school in Austin, Texas, and stated that before 1963, he “cleaned up construction sites” on commercial jobs including “sheetrock and lumber and trash” and indicated that he “was the clean-up kid” (LaFrentz Vol. I: p. 35, l. 24; p. 36, l. 19, 22; p. 37). He believed that the project involved remodeling rather than new construction (LaFrentz Vol. I: p. 37). He did not know if he was exposed to asbestos during this work (LaFrentz Vol. I: p. 37-38).

He also recalled that “one year [he] worked as an apprentice steamfitter” and believed that this was the following summer after the construction site job (LaFrentz Vol. I: p. 35, l. 24-25; p. 36, l. 1-2; p. 38). During this employment, he stated that he “helped one guy” and recalled that they were “redoing piping in the basement of an unoccupied hospital” (LaFrentz Vol. I: p. 38, l. 9-10). He indicated that the work he did was consistent with an apprentice, and that he would “put

goop on pipes and [screw] them in and all the old pipes out" (LaFrentz Vol. I: p. 38, l. 20-21). He did not recall if they took any insulation off of the piping systems they removed (LaFrentz Vol. I: p. 168). He agreed that "the whole area was always dusty" (LaFrentz Vol. I: p. 170). He did not recall whether he wore any type of dust mast while performing this work (LaFrentz Vol. I: p. 170).

He testified that he worked "one year [he] worked with the Texas Highway Department on the road crew" (LaFrentz Vol. I: p. 36, l. 1-2). He recalled that they "threw out and patched highways with asphalt" and "cleaned brush, picked up trash" (LaFrentz Vol. I: p. 39, l. 14-15).

Army Reserves/National Guard/Texas National Guard/Air Force Reserves (November or December 1964 to 1978)

Mr. LaFrentz testified that he was drafted in 1964 and reported to the Army National Guard in Camp Mabry in Austin, Texas (LaFrentz Vol. I: p. 40). He was later sent to Fort Bragg, North Carolina, and then Fort Lee, Virginia (LaFrentz Vol. I: p. 49). Following basic training, he recalled that he was in the reserves in the Texas National Guard and served in a "quartermaster's unit" which was "dealing with food and rations" (LaFrentz Vol. I: p. 50, l. 14, 17). He later became a helicopter mechanic and worked at Camp Mabry and Bergstrom Air Force Base or the Austin City Airport (LaFrentz Vol. I: p. 51). He also recalled working as the supervisor of a construction unit at La Crosse, Wisconsin, during his first year in Ohio (LaFrentz Vol. I: p. 52).

After moving back to Texas in 1978, Mr. LaFrentz stated that he joined the Air Force Reserves, and served in the reserves until 1991 (LaFrentz Vol. I: p. 52). He recalled that for the first two years, he was a machinist, and subsequently transferred and was accepted into intelligence; he stated that he then finished the last ten years of his service in the Air Force Intelligence, which involved providing intelligence briefings to flight crews (LaFrentz Vol. I: p. 53). Mr. LaFrentz testified that while he was working as a machinist in the reserves at Carswell Air Force Base, he "ran a lathe" and would get "called on to go out and take screws out of the panels in the aircraft" when they were "buggered up"; he described that they would take the old screws out and put new screws in (LaFrentz Vol. I: p. 163, l. 21-23; p. 164).

While working in intelligence, he testified that he would go "two, three weeks two or three times a year to some kind of an exercise. Turkey, Greece, Germany"; he recalled that he went to Incirlik, Turkey (LaFrentz Vol. I: p 160, l. 4-6).

Stereo Installation (1964-1970)

Mr. LaFrentz reported that he had a job installing "two-way radio systems in the trucks of the district supervisors" at the Texas Highway Department (LaFrentz Vol. I: p. 44, l. 12-13). He also recalled that he "installed eight-track stereos in cars" from approximately 1967 to 1970 for "a couple of years" (LaFrentz Vol. I: p. 41, l. 12-13, 24; p. 42).

Farming (Father-in-Law's Farm) (approximately 1970 or 1971 to 1978)

Mr. LaFrentz testified that he and his wife moved to Ohio for approximately five years after his father in law was injured to help him with his farm (LaFrentz Vol. I: p. 43-45).

Mobile Home Construction (1970-1971)

Mr. LaFrentz testified that he got a job in Bryan, Ohio, for approximately "a year and a half, two years" in which he was "working at a mobile home company the built mobile homes from… scratch" (LaFrentz Vol. I: p. 45, l. 19-20). He recalled that he did "plumbing, ran waterlines, helped with drywall… cleaned up the area" (LaFrentz Vol. I: p. 46, l. 2-3). He believed that he was present when they put insulation in the walls (LaFrentz Vol. 2: p. 144).

Aero (1971 or 1972-1978)

Mr. LaFrentz testified that he worked for the Aero Corporation from approximately 1971 or 1972 to 1978 as a machinist (LaFrentz Vol. I: p. 47). He recalled that he "ran a mill, a lathe" in the machine shop and did not typically visit other areas of the facility (LaFrentz Vol. I: p. 47, l. 10, p. 48). He described that the products being manufactured were "precision air tools" that were "used in surgery" (LaFrentz Vol. I: p. 47, l. 15, 18).

Machine and Lathe Operation (1978)

Mr. LaFrentz recalled that he moved back to Texas in 1978, and worked for a company for about a year where he was a "lathe operator" involving "big round blocks of metal" (LaFrentz Vol. I: p. 48, l. 13-14).

General Dynamics Corporation/Lockheed Martin (1979 – 2005)

Mr. LaFrentz testified that he went to work for General Dynamics at Carswell Air Force Base in Fort Worth, Texas, in 1978 or January 1979 (LaFrentz Vol. I: p. 55-56, 121-122). He recalled that the facility was building F-16 aircraft as well as some F-111 aircraft for the U.S. Air Force (LaFrentz Vol. I: p. 56-58). He believed that the aircraft built at the facility were built in accordance with U.S. Government military specifications (LaFrentz Vol. I: p. 126). He agreed that the facility where he worked was known as Air Force Plant Number 4, and was approximately a mile long, and he described that the building had "more or less two stories" to "facilitate the overhead crane" and that the building was 100 to 150 feet high (LaFrentz Vol. I: p. 114-115, Vol. 2: p. 149). He believed that the parts fab area where he specifically worked was "maybe 200 foot by 200 foot" (LaFrentz Vol. 2: p. 150).

He stated that he started as a drill press operator in the "parts fab department" with 30 to 40 other workers, and believed that he worked in this department for "probably a little over three years" from approximately 1979 to 1981 or 1982 (LaFrentz Vol. I: p. 58, l. 9, p. 59, l. 7, p. 87, 129; Vol. 2: p. 147). As part of this job he recalled that his duties included "basically anything that needed to be drilled, [he] would drill it. [He] drilled speed brakes out of raw aluminum. [He] drilled coupons for testing" and generally "drilled mostly anything" (LaFrentz Vol. I: p. 59, l. 15-18; Vol. 2: p. 152-153). He also recalled drilling some brass parts and some steel (LaFrentz Vol. 2: p. 153). He recalled using a half-inch drill bit (LaFrentz Vol. 2: p. 158). He described that a "coupon" was "the honeycomb" and "came in three different varieties" (LaFrentz Vol. I: p. 59, l. 25; p. 60, l. 1). Regarding the coupon or honeycomb, he indicated that "one was a panel and one was a strip" and that "the panels were composite material on top of a metal plate" (LaFrentz Vol. I: p. 60, l. 3-4). He later agreed that there were three different types of coupons: honeycomb, panel, and strip, but also agreed that coupon and honeycomb were the same (LaFrentz Vol. I: p. 131). Later still, he testified that Honeycomb, panel, and strip were different shapes (LaFrentz Vol. 2: p. 113). He stated that he "dealt with a honeycomb-type of a panel", and that he also "dealt with a panel that had metal base on it" and that he "dealt with a strip of that panel (LaFrentz Vol. 2: p. 114, l. 21-23; Vol. 2: p. 164). He agreed that there was a document produced as an exhibit that addressed the use of adhesive in the panels (LaFrentz Vol. 2: p. 162).

Mr. LaFrentz described a honeycomb panel as a "quarter inch of material across the top and then a wafered-type center and then this panel or this same type of composite material on the bottom"; he recalled that the dimensions of most of the honeycomb panels he worked on were "eight by ten by inch and a half, inch and a quarter thickness for the panel" (LaFrentz Vol. I: p.

131, l. 17-20, 23-24). He later estimated the thickness of the panels as approximately 5/16ths of an inch (LaFrentz Vol. I: p. 133). He recalled that the look of the composite material did not change during the approximately three-year period he performed work with the coupons, but he did not know if the chemical composition ever changed (LaFrentz Vol. I: p. 132-133). He testified that the strip coupons he recalled were “probably 11 by one and a half by the thickness” (LaFrentz Vol. I: p. 134, l. 3-4). He recalled that the composite strips were “a yellow-ish color” and had different colors (LaFrentz Vol. 2: p. 120).

He agreed that the coupons were test panels for combat aircraft and later stated that he believed they were used for strength testing (LaFrentz Vol. I: p. 116, 126). He recalled that on the panels, they “drilled the four corners so they could stretch them and see what it took to break them”; he stated that the “strip was … basically the same thing, but it was just more or less composite-type material” that they “drilled at each end for them to test” (LaFrentz Vol. I: p. 60, l. 5-6, 9-11, 13-14, Vol. 2: p. 115-116). After his work as a drill press operator, Mr. LaFrentz testified that he became an “NC machinist” for approximately two years, and recalled that in this position he worked on “three and a five-axis machine milling and drilling and everything that needed to be done to that particular part” (LaFrentz Vol. I: p. 60, l. 21-23).

Regarding his work with the “coupons” or honeycomb, Mr. LaFrentz testified that “they would bring them out in a plastic bin” and “there may [have been] 20 or 30 or so in that bin” (LaFrentz Vol. I: p. 65, l. 8-9, 11-12). He described that he “might have to do this for two days” and then he “might… not have another bin come out for a month” (LaFrentz Vol. I: p. 65, l. 12-13). He recalled if the coupon was a single strip, he would have “two holes to drill and clean up” and “that would take from start to finish probably 30 to 45 minutes” (LaFrentz Vol. I: p. 65, 66, l. 3-6). He later testified that if it was “a strip panel, it had two holes” and would take “probably 20, maybe 30 minutes at the most” from start to finish to drill, sand, and deburr the panels each time (LaFrentz Vol. 2: p. 168). He further explained that “if it was a panel that was… [a] metal panel that had four holes in it, it would probably take 30, 40 minutes” and finally, “if it was a honeycomb panel, it would take about 15, 20 minutes” (LaFrentz Vol. 2: p. 168, l. 11-17).

He testified that he drilled these panels “off and on” during the three years that he worked as a drill press operator, and did not ever drill them again once he was no longer a drill press operator (LaFrentz Vol. I: p. 66, l. 20). He believed that during this three-year period, he could have drilled “maybe a thousand” of the coupons or panels and stated that he knew “there was quite a few” (LaFrentz Vol. I: p. 67, l. 10, p. 113; Vol. 2: p. 165-166). He later stated that it would take him

"around 15 minutes to 25 minutes" to clean up after he had drilled the panels, or around 30 minutes to an hour to clean his table, fixture, and the floor (LaFrentz Vol. 2: p. 118).

In describing the drilling process of the coupons or panels, he stated that, "if it was a larger panel, which would be something about the size of a piece of paper, it had four holes and it had a fixture" (LaFrentz Vol. I: p. 68, l. 15-17). He agreed that this drilling process would be dusty because he could not use any dust-suppression solution on the panels (LaFrentz Vol. I: p. 69). He also recalled that there was an odor associated with drilling the panels, and it "smelled like something was burning up" (LaFrentz Vol. I: p. 70, l. 7-8). He also described that the drilling process was "always leaving, like, burrs around the hole and the engineers wanted them smooth so they could test them", so he "would have to take and either use the little belt sander we had there to kind of run over it or use the air hand sander" which "had a little disc pad on the end of it" (LaFrentz Vol. I: p. 70, l. 11-17). He also described that he used a "one inch" belt sander and that he would also use an air powered hand drill with a two-inch disc (LaFrentz Vol. 2: p. 117). He further recalled that sometimes he would use a "whirligig" which was "just a little handle that you whipped around inside the hole" (LaFrentz Vol. I: p. 71, l. 19-22). He stated that after he finished drilling the coupon, he would "put that one in the little plastic bin" and "picked up the next one" (LaFrentz Vol. I: p. 73, l. 2-3). He recalled that each little plastic bin held between eight and 14 parts (LaFrentz Vol. 2: p. 118-119). He then recalled that he would clean up (LaFrentz Vol. I: p. 73).

When asked about the process of cleaning up after drilling a bin of coupons, Mr. LaFrentz testified that he would "have to turn around and get … kind of a desk brush", which he described was a "long-handled brush" to sweep up his desk and the floor; he also believed that sometimes the material "would be stuck in the fixture" so he would have to "get the air hose out and blow the air hose over the fixture to clean it up" and recalled that this process would be dusty (LaFrentz Vol. I: p. 88, l. 13-20).

Mr. LaFrentz believed that he was exposed to asbestos during his work at General Dynamics because of documentation related to air monitoring that was performed in his "work area" (LaFrentz Vol. I: p. 64, l. 3; LaFrentz Exhibit Plaintiff 2).

Following Mr. LaFrentz's work in machining, he testified that he "moved into special program security" and that in this position, he "worked in programs that had to be cleared by the government, and basically kept all of the documentation, the facilities, and the access list secured" (LaFrentz Vol. I: p. 61, l. 8-11).

- Workplace Air Sampling

Mr. LaFrentz reported that he complained to his management regarding the conditions of his work, and called the "safety engineer" about it (LaFrentz Vol. I: p. 82, 83, l. 5). He recalled that her name was B.J. Hallstein, and that when he contacted her, she set up a time to "[test] the air while [he] was drilling" (LaFrentz Vol. I: p. 84). He stated that he gave her a copy of the results in a "little document" that he kept until the time of his deposition; he did not recall the working conditions of his job changing after receiving the results (LaFrentz Vol. I: p. 84, l. 10, p. 85). He indicated that the report stated the contaminant being evaluated was "asbestos" and that there was a concentration of "28.8 fibers per centimeter" (LaFrentz Vol. I: p. 91, l. 8-9). He recalled that he was working on a strip with two holes at the time of the air sampling (LaFrentz Vol. 2: p. 121).

He stated that Ms. Hallstein had "no comment about" whether it was safe or not safe to be drilling and sanding the coupons, and provided "no instructions" regarding whether to continue wearing the same respiratory protection; he did not recall anyone telling him to change his work practices after the air sampling that was performed (LaFrentz Vol. I: p. 86, l. 2; Vol. 2: p. 159). Mr. LaFrentz testified that he personally became aware of what asbestos was "back in '95, 6, somewhere like that" (LaFrentz Vol. I: p. 93, l. 13-14).

- Respiratory Protection

Mr. LaFrentz testified that during the coupon drilling process, he "had a mask on" which he described as a "dust mask" that he "got from the parts man" (LaFrentz Vol. I: p. 72, l. 7, p. 73). He stated that he was not aware of any policies that required him to use a dust mask while performing the coupon drilling work (LaFrentz Vol. I: p. 74). He did not recall whether he had a dust mask on the very first time he started drilling (LaFrentz Vol. I: p. 74). He stated that he was first prompted to request a dust mask for this work because he was "trying to get away from all the black dust and smell"; he later described a "black fog" (LaFrentz Vol. I: p. 74, l. 25 – p. 75, l. 1; Vol. 2: p. 168). He indicated that he would wear the mask "all the time"(LaFrentz Vol. I: p. 80, l. 17).

Mr. LaFrentz recalled that when he asked for the dust mask, he went to a parts cage about "50 feet or so" from where he was working (LaFrentz Vol. I: p. 77, l. 5). He recalled that they "took a paper mask" out of a "four by four by six cardboard box" and handed it to him (LaFrentz Vol. I: p. 77, l. 25; p. 78, l. 1). He believed that the mask "was a 3M dust protector" and that it "was 8710" (LaFrentz Vol. I: p. 78, l. 4, 7). He recalled that the mask "was kind of whitish-gray with two yellow

bands on it" and had metal across the nose; he did not recall if anything was written on the mask (LaFrentz Vol. I: p. 78, l. 9-10). He reported that he did not have any facial hair during that time or ever (LaFrentz Vol. I: p. 78-79). He believed that he wore the same mask during the three years he was a drill press operator (LaFrentz Vol. I: p. 81). He recalled that "most of the time", he would wear the same mask all day (LaFrentz Vol. I: p. 82, l. 3). He also recalled that "sometimes" he would wear the same respiratory protection once he became a machinist (LaFrentz Vol. I: p. 86, l. 20). He later clarified that it was "probably a week until [he] got the mask" after he started drilling the panels (LaFrentz, Vol. 2: p. 106, l. 8).

Mr. LaFrentz testified that he did not ever see an instruction sheet with the 3M 8710, or any product warnings, literature, brochures, or advertisements (LaFrentz Vol. 2: p. 108).

- Workplace Safety

Mr. LaFrentz testified that while he was working in "parts fab", there was a 30-minute safety meeting every "Monday morning or Friday morning"; he did not recall asbestos or dust being discussed at these meetings (LaFrentz Vol. I: p. 95, l. 4-5). He recalled that he was required to get a physical exam and x-rays before he started working at General Dynamics, but did not require ever doing any x-rays again while he worked there (LaFrentz Vol. I: p. 96). He recalled that he was issued safety goggles, but testified that he was not provided with any type of work uniform (LaFrentz Vol. 2: p. 151). He reported that he would not get an apron "unless [he] knew it was going to be a real dirty job" (LaFrentz Vol. 2: p. 152). He believed that General Dynamics "had a pretty good safety record" (LaFrentz Vol. I: p. 98, l. 7). He indicated that he did not have in his possession any manuals or newsletters from the time of his employment (LaFrentz Vol. I: p. 123).

IV. OVERVIEW OF OPINIONS

1) The 3M respirator model 8710 identified by Mr. LaFrentz was not an asbestos-containing product and did not add to particle or asbestos exposure potential through its use. Respiratory protection can only serve to reduce exposure to airborne contaminants, especially when worn and used in conjunction with a properly administered respiratory protection program as specified by ANSI Z88.2 and OSHA 1910.134.

2) State and Federal guidance, standards, and laws relating to appropriate use of respiratory protection have been in place throughout much of the past century. These standards emphasize the hierarchy of controls and the use of respiratory protection only in certain instances and as a last resort following the implementation of other controls, such as ventilation, engineering controls, and work practice controls.

3) The applicable regulations and standards clearly state the responsibility of employers to implement and maintain an appropriate worker protection program, including a respiratory protection program with the necessary elements as set forth in OSHA Section 1910.134 if respirators will be used in the workplace.

4) According OSHA 1910.93a (1972), the class of respirators which includes the 3M 8710 respirator was approved for use with airborne particulates, including asbestos, and provided protection up to 10 times the OSHA ceiling or 8-hour TWA permissible exposure limit for asbestos when used appropriately within an employer-established respiratory protection program, as required by law.

5) Industrial hygiene knowledge regarding asbestos has evolved through the process of incremental scientific study. From the early 1900s until the late 1960s, industrial hygienists were primarily focused on occupations with very high asbestos exposures, including mining and asbestos textile and products manufacturing. The evaluation of exposure potential to end users of asbestos-containing products was not a focus of industrial hygienists until the mid- to late 1960s through 1970s.

6) According to his testimony, Mr. LaFrentz operated a drill press at General Dynamics Corporation/Lockheed Martin for approximately three years between 1979 and 1981 or 1982. He recalled work with aircraft test panels approximately two days per month during this time period. Based on the peer-reviewed literature and measured airborne fiber

concentrations during belt sanding activities in Mr. LaFrentz's work area during his employment, his cumulative airborne fiber exposure potential during this work would have been well below the cumulative asbestos exposure potential associated with working at the current OSHA PEL for asbestos over 45 years, and also within or below the range of cumulative lifetime ambient or background exposures experienced by anyone in the general U.S. population.

7) Nevertheless, Mr. LaFrentz testified that he always wore a 3M 8710 respirator after an initial short period of time working with the aircraft test panels, which if used appropriately, would have provided protection up to 10 times the OSHA ceiling or 8-hour TWA PEL for asbestos and resulted in an even lower cumulative airborne fiber exposure potential during this work.

8) Mr. LaFrentz described work with and around insulation during his work as a steamfitter apprentice and potentially at other work locations during his career. Based on the published literature, full-shift airborne fiber concentrations during work with asbestos-containing insulation were likely to have been above or well above the current OSHA full-shift exposure limit for asbestos. Depending on the fiber type, the nature and duration of activities, and potentially other factors, Mr. LaFrentz may have experienced additional exposures during his working lifetime. Because discovery in this case is ongoing, I reserve the right to supplement my opinions in this regard if additional information becomes available.

V. BASIS FOR OPINIONS

Background: Asbestos

The term asbestos comes from the Greek word meaning “unquenchable” or “indestructible.” The two commercial groups of asbestos minerals are serpentine and amphibole, with only one commercial mineral, chrysotile, in the serpentine group (Virta 2005). The amphibole group, on the other hand, contains several mineral fiber types including both crocidolite and amosite (Virta 2005). Each of these mineral fiber types has a unique chemical composition (Virta 2005).

In 1946, the American Conference of Governmental Industrial Hygienists (ACGIH), a professional organization of industrial hygienists and other occupational and environmental health professionals, disseminated the first set of acceptable occupational exposure limits, referred to at that time as Maximum Allowable Concentrations (MACs), for a number of commonly-used industrial chemicals, including asbestos. The MAC values were later renamed the Threshold Limit Values (TLVs). The TLVs were set using the best available scientific literature of the time, representing the amount of exposure that it was believed a worker could experience for eight hours a day, 40 hours a week, 50 weeks a year, for a working lifetime of 45 years without adverse health effects. ACGIH clarified that the TLVs “should not be regarded as fine lines between safe and dangerous concentrations” (ACGIH 1955: p. 46). The ACGIH believed that for substances thought to pose a chronic health issue, like asbestos, the important occupational exposure limit would be the full-shift time-weighted average (TWA) concentration; this approach meant that a worker could be exposed to concentrations higher than the TWA for limited periods, so long as the average concentration over eight hours remained below the 8-hour TWA (ACGIH 1955). At this time, the ACGIH adopted a value of 5 mppcf as the recommended full-shift daily exposure limit for all mineral types of asbestos based on the Dreessen et al. (1938) study (ACGIH 1968). This TLV for asbestos was based on the experience in the asbestos textile industry and was intended to protect workers from asbestosis. This 8-hour TWA TLV for asbestos remained the acceptable ACGIH exposure limit through the 1950s and up until 1968 (ACGIH 2001).

In 1968, the ACGIH proposed to change their asbestos TLV and recommended a new ceiling limit of 5 mppcf and an 8-hour TWA TLV of 2 mppcf or 12 f/cc for fibers greater than 5 µm in length. Again in 1970, ACGIH proposed to lower the TWA TLV to 5 f/cc for fibers longer than 5 µm in length, and added a short term exposure limit of 10 f/cc, longer than 5 µm in length, as averaged over 15 minutes. ACGIH adopted the lower TWA TLV for asbestos in 1974 at 5 f/cc greater than

5µm in length and included the designation "human carcinogens ... with an assigned TLV" (ACGIH 1974a; 1974b: p. 46).

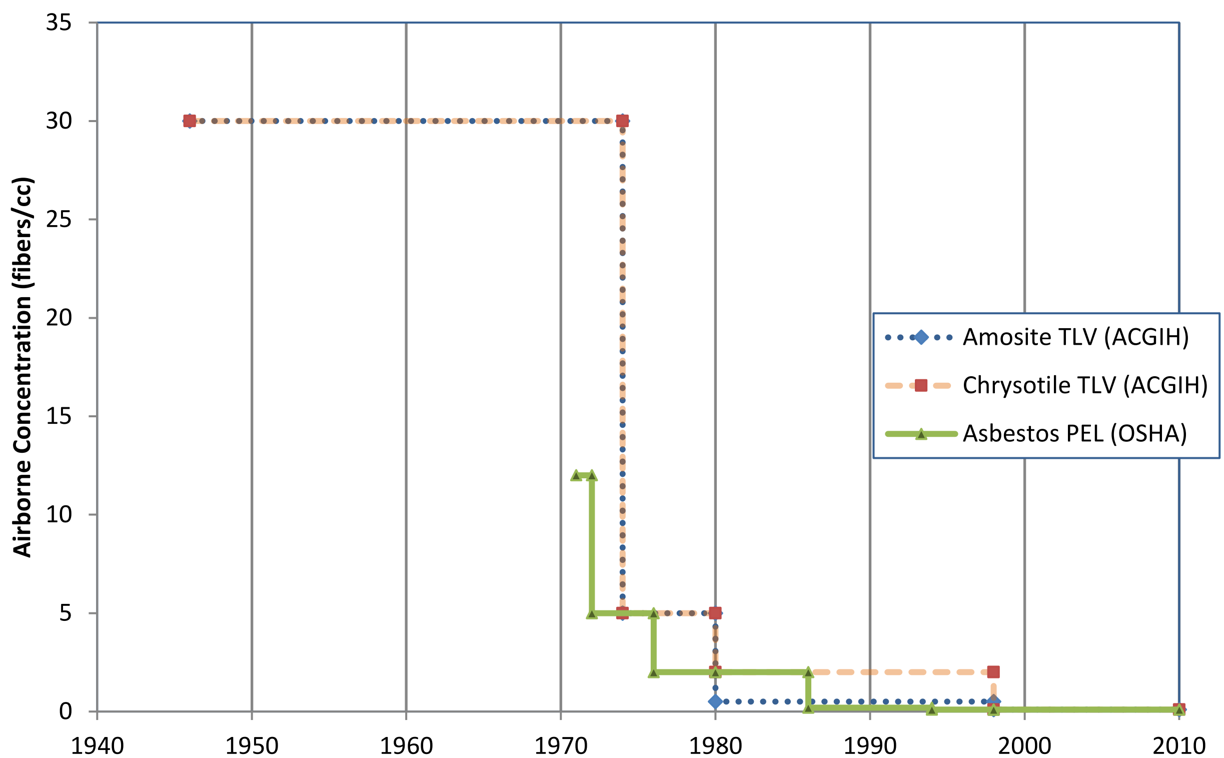
The first U.S. Occupational Safety and Health Act was passed at the end of 1970, and in 1971 the newly formed Occupational Safety and Health Administration (OSHA) promulgated regulatory requirements for the first time for asbestos that were legally binding in a majority of workplaces in the United States. Authorized by Congress under the OSH Act, OSHA adopted the existing Walsh-Healey standards, which included the 12 f/cc or 2 mppcf eight-hour TWA for asbestos, referred to as a Permissible Exposure Limit (PEL) (OSHA 1971b). The PELs for asbestos over time have been based on both an eight-hour TWA using the same methodology established by the ACGIH TLVs as well as 15- or 30-minute short-term TWAs for exposures above the eight-hour TWA. In 1972, OSHA reduced the asbestos PEL to 5 f/cc as an eight-hour TWA, and also stated that "[n]o employee shall be exposed at any time to airborne concentrations of asbestos fibers in excess of 10 fibers, longer than 5 micrometers, per cubic centimeter of air", which was referred to as a 'ceiling concentration'. In subsequent documentation, OSHA clarified that "[a]lthough the existing standard's ceiling limit of 10 f/cc did not include a time period, OSHA had administratively interpreted this provision as prescribing 10 f/cc over a 15 minute period" (OSHA 1986, p. 22682). The 1972 standard included a reduction of the eight-hour TWA PEL to 2 f/cc in 1976 (OSHA 1972b).

In 1983, in conjunction with Dr. William Nicholson of the Environmental Sciences Laboratory of the Mt. Sinai School of Medicine (OSHA Contract #J-94-2-0074) OSHA published a Quantitative Risk Assessment for Asbestos-Related Cancers (OSHA 1983b). In this risk assessment, OSHA used a linear, no-threshold model to estimate the risk for lung cancer and mesothelioma associated with asbestos exposure. For mesothelioma specifically, the agency used exposure information from four studies with high historical exposures to amphiboles or mixed fiber types to extrapolate the risk for disease at lower exposures down to zero (Selikoff et al. 1979; Seidman et al. 1979; Peto 1980; Finkelstein 1983). This model was used by OSHA to determine a value for the updated OSHA 8-hour TWA PEL for asbestos in 1986. In its 1986 standard, OSHA stated that an absolute risk model was used to estimate the risk of mesothelioma in which the "magnitude of the risk increases linearly with intensity of exposure" and "exponentially with duration of exposure and time from onset of exposure" (OSHA 1986, p. 22638). OSHA reported that it used directly-observed risks in worker populations with "past exposures … higher than those permitted today" in estimating "risk at lower exposure levels" (OSHA 1986, p. 22632). OSHA has continued to use the same risk assessment in subsequent updates to the PELs for asbestos. OSHA lowered the eight-hour TWA PEL to 0.2 f/cc in 1986 and then to the existing level of 0.1 f/cc in 1994; the U.S.

EPA has used the same risk assessment approach for non-occupational scenarios (OSHA 1986; USEPA 1986a; OSHA 1994) (See **Figure 1**). OSHA stated that their 1986 "final standard does not designate a ceiling limit for exposure to asbestos" (OSHA 1986). In 1988, OSHA added an excursion limit of 1 f/cc averaged over a sampling period of 30 minutes (OSHA 1988). In 1990, this excursion limit was also referred to as "a short-term excursion limit (STEL)" (OSHA 1990).

It should also be noted that in 1978, ACGIH recommended that the TLV for asbestos be differentiated by fiber type (ACGIH 1978). According to the ACGIH, different TLVs were warranted based on the weight of available evidence for three different types of asbestos fibers, including crocidolite, amosite, and chrysotile. The recommended TLV for each of these three fibers was 0.2 f/cc, 0.5 f/cc, and 2 f/cc, respectively. The ACGIH stated that "the exposure level of crocidolite and amosite… must be sharply lower than that of chrysotile because of their greater potential for disease production" (ACGIH 1980). In 1997, the ACGIH proposed to lower the eight-hour TWA TLV to 0.1 f/cc for all mineral forms of asbestos and adopted this value in 1998 (ACGIH 1998).

Figure 1: Changes in the Asbestos ACGIH TLVs and OSHA PEL Over Time*



* 5 mppcf was determined to be roughly equivalent to 30 f/cc (Lynch et al. 1968).

Estimating Cumulative Exposure

The exposure assessment process for any substance with the potential for chronic effects, including asbestos, typically includes quantifying to the extent possible the cumulative exposure, or the amount of contact or exposure to the agent of interest over time by all possible routes of entry into the human body. The use of a transparent, step-wise process to assess cumulative exposure is extremely important to produce consistent results from study to study, and is also likely to improve the quality of estimates generated (Sahmel et al. 2010). A number of publications have discussed systematic approaches to the exposure assessment and reconstruction process (Viet et al. 2008; Armstrong et al. 2009; Sahmel et al. 2010; Jahn et al. 2015). The three critical parameters for assessing exposures, and ultimately determining a consistent metric of cumulative exposure, include the duration, frequency, and magnitude or intensity of the exposure. According to the American Industrial Hygiene Association's textbook entitled A Strategy for Assessing and Managing Occupational Exposures, Fourth Ed., sample duration is "one of three important parameters used to describe the extent and potential consequences of exposures; the other two parameters are frequency and magnitude of exposure" (Jahn et al. 2015, p. 537). Similarly, the ATSDR has described that there are a number of factors to consider in determining the potential harm associated with asbestos exposure, including "the dose (how much), the duration (how long), the fiber type (mineral form and size distribution), and how you come in contact with it" (ATSDR 2001, p. 1, 126).

Cumulative Lifetime Exposure – C (f/cc-year)

To estimate cumulative lifetime asbestos exposure potential (C), the following equation can be used (Eq. 1). Each of the parameters in Equation 1 is defined below.

$$C = C_{8hr} \times E_D \qquad \text{(Eq. 1)}$$

Exposure Concentration – C_{8hr} (f/cc as an 8-hour TWA)

The first parameter necessary for estimating exposure potential is the airborne fiber concentration during the work being performed. It is important to use an estimate or calculation of the exposure concentration that characterizes the full work day, or full shift exposure potential, as an 8-hour Time-Weighted Average (TWA). This estimate of full shift exposure potential can represent direct exposures, bystander exposures, or ambient exposures, as examples.

Exposure Duration and Frequency – E_D (years)

The second parameter necessary for estimating exposure potential is the amount or duration of exposure, which encompasses the duration and frequency of exposure over time. For full shift exposure potential, exposure duration can be characterized in terms of days (as a fraction of a year) or years of exposure on either an occupational or environmental year basis. An occupational year consists of 2,080 hours and an environmental year consists of 8,760 hours.

General U.S. Population Ambient/Background Exposures to Asbestos

The U.K. Committee on Carcinogenicity stated that ambient conditions are "the normal conditions surrounding a person," which includes both indoor and outdoor air (Committee on Carcinogenicity 2013, p. 3). Based on its evaluation, the committee reported that the levels of airborne respirable fibers are generally highest in buildings with asbestos that has been disturbed, damaged or is in bad condition, followed by buildings with asbestos in "good condition" and buildings not constructed with asbestos, and are generally lowest in outdoor ambient environments (Committee on Carcinogenicity 2013, p. 12). Based on U.S. EPA data of ambient asbestos levels in buildings with no asbestos-containing material (ACM), buildings with ACM in good condition, and buildings containing damaged ACM, Crump and Farrar (1989) reported similar findings, but found no statistically significant difference in the airborne asbestos levels detected among the three building types (Crump et al. 1989). The Agency for Toxic Substances and Disease Registries (ATSDR) stated in their 2001 Toxicological Profile for Asbestos that the estimated range of indoor ambient concentrations for asbestos is 0.00003 – 0.006 f/cc, which corresponded to cumulative lifetime exposures of 0.002 – 0.4 f/cc-year (ATSDR 2001, p. 151). This range is also consistent with the range of ambient cumulative lifetime exposures for the U.S. population, based on exposure to a combination of indoor and outdoor background asbestos-specific airborne concentration measurements. According to Nolan and Langer (2001), 18.6% of all fibers detected in the indoor and outdoor ambient air were at least 5 µm in length or longer.

Asbestos-specific airborne concentration measurements for fibers of at least 5 µm in length published in the peer-reviewed literature for outdoor ambient or background exposures to asbestos have been reported to be in the range of 0.00003 to 0.0047 f/cc (Nolan et al. 2001; Sahmel et al. 2014a; Lee et al. 2008). Based on these recent data, lifetime cumulative outdoor ambient or background exposures to asbestos experienced by the general U.S. population over 70 years are in the range of 0.0021 to 0.33 f/cc-year (Nolan et al. 2001; Sahmel et al. 2014a; Lee

et al. 2008). Abelmann et al. (2015) conducted a review and analysis of outdoor asbestos air concentrations measured in “the absence of known or potential asbestos emission sources” from the 1960s until the 2000s and reported a mean ambient fiber concentration of 0.00093 f/cc (range: non-detect – 0.050 f/cc) which corresponds to a mean lifetime cumulative exposure of 0.0651 f/cc-year (range: non-detect – 3.5 f/cc-year) (Abelmann et al. 2015, p. 754). It is important to note that the analysis conducted by Abelmann et al. included PCM measurements, which do not distinguish asbestos fibers from other fibers and “may overestimate the true asbestos fiber concentration compared to TEM” measurements in combination with PCM (Abelmann et al. 2015). Similarly, the ATSDR reported a worldwide ambient outdoor range of 0.00001 f/cc for rural areas and 0.0001 f/cc for urban areas based on TEM; the Health Effects Institute- Asbestos Research (HEI-AR) stated that “asbestos fibers of the dimensions most relevant to human health (that is, fibers longer than 5 µm)” were included in these estimates, although the data or studies relied upon for these values were not specified and therefore had unknown relevance to the U.S. population specifically (ATSDR 2001; HEI-AR 1991). Although outdoor ambient asbestos concentrations reported in the literature are generally lower than reported indoor ambient asbestos concentrations, a comparative analysis of airborne asbestos concentrations measured inside and outside 49 buildings performed by Crump and Farrar (1989) suggested that “[n]o statistically significant differences were detected in asbestos levels between indoors and outdoors” (Crump et al. 1989, p. 51).

The U.S. population spends more time indoors than outdoors each day. According to the U.S. EPA Exposure Factors Handbook (2011), an individual spends on average 20 hours indoors (range: 19.0-24 hours) per day and four hours outdoors (range: 0.0-5.0 hours) per day, weighted for age differences over a 70-year lifetime (USEPA 2011). Considering the lowest and highest measured asbestos-specific airborne concentrations of fibers reported in the literature for the U.S., I calculated the range of lower bound and upper bound U.S. lifetime ambient asbestos cumulative exposures based on the number of hours per day, on average, a person spends indoors and outdoors (Lee et al. 2008; Nolan et al. 2001; ATSDR 2001; Nicholson 1987; Crump et al. 1989; Heffelfinger et al. 1972). The lifetime ambient cumulative exposure range using this approach ranged from 0.002 to 0.4 f/cc-yr (**Table 1**).

Table 1. Lifetime ambient cumulative exposure range based on the lowest and highest measured asbestos-specific airborne fiber concentrations.[a b]

Location	Hours	Lower Bound (f/cc)	Upper Bound (f/cc)
Indoor	20	0.00003	0.006
Outdoor	4	0.000003	0.0047
24-hr TWA (f/cc)		0.00003	0.006
Cumulative Exposure 70 years (f/cc-yr)		**0.002**	**0.4**

[a] Based on measurement data for fibers ≥ 5µm in length and asbestos-specific, when possible; for comparison, historic converted data in ng/m^3 were also considered

[b] References: ATSDR 2001; Lee & Van Orden 2008; Nolan & Langer 2001; Nicholson 1987; Heffelfinger et al. 1972; Crump and Farrar 1989

This combined indoor and outdoor ambient cumulative exposure range is consistent with the indoor background cumulative exposure range reported by the ATSDR, given the average number of hours that individuals spend indoors each day according to the U.S. EPA. It should also be noted that if the lower bound worldwide outdoor ambient concentration reported by ATSDR and HEI of 0.00001 f/cc were used in this calculation instead, the resulting cumulative exposure would remain the same. Further, it is possible that these values may underestimate historic ambient cumulative asbestos exposures. According to Abelmann et al., "ambient asbestos concentrations generally increased from the 1960s through the 1980s, after which they declined considerably" (Abelmann et al. 2015, p. 761). And finally, all of these ambient cumulative exposure values for the general U.S. population would be higher if converted to an equivalent occupational cumulative exposure potential rather than the environmental cumulative exposure potential reported above (i.e., cumulative exposure potential over 2080 hours per occupational year compared with 8760 hours per environmental year). Such a conversion allows for a more direct comparison to epidemiological evidence of the cumulative asbestos exposure potential associated with disease. Researchers have reported that this comparison factor is 4.2 (Camus et al. 2002; Reid et al. 2008). Using the factor of 4.2 results in an equivalent occupational cumulative exposure range of 0.0084 f/cc-year to 1.68 f/cc-year, compared to the environmental cumulative exposure range of 0.002 to 0.4 f/cc-year.

Studies that have conducted air monitoring of ambient indoor and outdoor air have found measurable concentrations of both chrysotile and amphibole fibers, including tremolite, actinolite, amosite, and anthophyllite fibers (Cal/EPA Air Resources Board 2015; Lee et al. 2008; Baxter et al. 1983b, 1983a; Crump et al. 1989). According to Nicholson (1987) "asbestos of the chrysotile variety has been found to be a ubiquitous contaminant of air" (Nicholson 1987, p. 7). As reported by the ATSDR, a study of indoor air in homes, schools, and other buildings that contain asbestos materials found that both chrysotile and amphibole fibers are measurable in ambient air (Lee et al. 1992). Similarly, Abelmann et al. stated that their study was a combined analysis of data for all fiber types (Abelmann et al. 2015).

A number of published epidemiology studies have suggested that exposures to ambient asbestos concentrations of any fiber type are not associated with a significantly increased incidence of asbestos-related disease (Price et al. 2004, 2005; Teta et al. 2008; Moolgavkar et al. 2009; Antman et al. 1997; McDonald 1985; McDonald et al. 1994; Moore et al. 2008). For example, Price and Ware (2004) state that although women's environmental exposures would likely have increased since the 1930s with the increasing use of asbestos in the U.S., "the mesothelioma risk for women has not increased" (Price et al. 2004, p. 111). They note that "[e]nvironmental exposure levels, although increasing, have not triggered a risk response in women. Therefore, those exposure levels must have been below a threshold for mesothelioma" (Price et al. 2004, p. 111). Further, a recent study that I conducted with several colleagues (Glynn et al. 2018) indicated that there was no increase in incidence rates of pleural mesothelioma among females in urban versus rural areas in the U.S. between 1973 and 2012, despite measured differences of up to 10 fold or more in ambient airborne asbestos concentrations between these different geographical areas (Glynn et al. 2018). These results suggest that ambient exposures to asbestos over a wide range of background concentrations have not significantly affected the incidence of pleural mesothelioma in the U.S. over the past 40 years, and that each incremental fiber exposure cannot be assumed to contribute to disease risk at similarly low concentrations.

OSHA noted that, based on widely varying background levels of asbestos and the technological feasibility of measuring levels below 0.1 f/cc in the workplace, "the Agency cannot make the general statement that any exposure above ambient background levels presents a significant risk" (Jeffress 1999). Moreover, the U.S. EPA stated that "[e]xtrapolation of risks of asbestos cancers from occupational circumstances can be made, although numerical estimates in a specific exposure circumstance have a large (approximately tenfold) uncertainty" and acknowledged that, "[b]ecause of this uncertainty, calculations of unit risk values for asbestos at the low concentrations measured in the environment must be viewed with caution" (USEPA

1986a, p. 2). The policies of the U.S. EPA and NIOSH state that when the mode of action for any carcinogen is unknown, a linear no-threshold extrapolation model is to be used (NIOSH 2017; USEPA 2017). The U.S. EPA has reported that the risk assessment procedures set forth in their guidelines are more likely to overstate than understate risk, and linear extrapolation models "[do] not necessarily give a realistic prediction of the risk" and the "true value of the risk is unknown, and may be as low as zero" (USEPA 2005; 1986b, p. 13).

OSHA Standards, Warning Label Requirements, and Exemptions Over Time: Encapsulated Products

A notable exception to the on-going evaluation of end-user exposures associated with asbestos-containing products in the 1970s and 1980s was the use of products that were considered encapsulated. It was recognized well before 1980 that encapsulated products did not pose an exposure concern consistent with friable asbestos-containing products.

In the 1930s, researchers acknowledged the risk of asbestosis for those employed in the asbestos processing and manufacturing industries, except where processes involved "articles composed wholly or partly of woven asbestos impregnated with bitumen or other bond of an adhesive nature" (Lanza 1938, p. 391; Home Office 1935). Asbestos industry compensation programs for the workers at risk did not apply to those working with such asbestos products that included an adhesive binder (Lanza 1938).

In 1970, Selikoff noted that products in which "the asbestos is 'locked in' - that is, it is bound with cement or plastics or other binders" would result in no significant release of asbestos fibers in either working areas or the general environment (Selikoff 1970).

No known requirements for labeling of asbestos-containing products existed prior to 1970s (Kopelovich et al. 2014). In 1972, OSHA first required that "[c]aution labels shall be affixed to all raw materials, mixtures, scrap, waste, debris, and other products containing asbestos fibers, or to their containers, except that no label is required where asbestos fibers have been modified by a bonding agent, coating, binder, or other material so that during any reasonably foreseeable use, handling, storage, disposal, processing, or transportation, no airborne concentrations of asbestos fibers in excess of the exposures limits … will be released" (OSHA 1972b, p. 11321). It was not specified in the federal register who or what party was responsible for this labeling requirement.

OSHA's Hazard Communication Standard

In 1983, OSHA promulgated the Hazard Communication Standard that required "chemical manufacturers and importers to assess the hazards of chemicals which they produce or import, and all employers in SIC Codes 20 through 39 (Division D, Standard Industrial Classification Manual) to provide information to their employees about the hazardous chemicals to which they are exposed" (OSHA 1983a, p. 53340). The standard also indicated that the "chemical manufacturer, importer, or distributor shall ensure that each container of hazardous chemicals leaving the workplace is labeled, tagged or marked with (i) Identity of the hazardous chemical(s); (ii) Appropriate hazard warnings; and (iii) Name and address of the chemical manufacturer, importer, or other responsible party" (OSHA 1983a, p. 53343).

An OSHA directive effective March 20, 1998, provided clarifications to and interpretations of Hazard Communication Standard (HCS) provisions where "significant interpretations have been necessary to ensure uniform enforcement and understanding" (OSHA 1998b). OSHA instructed that only chemical manufacturers and importers were required to perform hazard determinations on the chemicals they produced or imported. Distributors and employers could choose to perform their own evaluation, but an employer could also rely on the hazard determination performed by the manufacturer. The new language in the February 9, 1994, Final Rule indicated that manufacturers were to consider the "health *risk* to downstream users when components of a mixture could be released", whereas the previous language used the term 'health *hazard*' (OSHA 1998b). The language change was due to the recognition that "hazard is an inherent property of the chemical", but "[h]ealth risk is a function of the inherent hazard and the exposure level" (OSHA 1998b). According to the inspection guidelines, a "complete exemption from all requirements of the HCS applies" to manufactured items that, "under normal conditions of use it does not release more than very small quantities, e.g., minute or trace amounts of a hazardous chemical … and does not pose a physical hazard or health risk to employees" (OSHA 1998b). Further, the directive instructed that any substance "inextricably bound in a product is not covered under the HCS"; for example, if a hazard determination for a product revealed that a substance was bound and "under normal conditions of use or during foreseeable emergencies cannot become airborne and, therefore, cannot present an inhalation hazard", then that substance "need not be indicated as a hazardous ingredient since it cannot result in employee exposure" (OSHA 1998b).

OSHA's Asbestos Standards and Encapsulated Product Language

In 1986, OSHA's updated asbestos regulatory language required that signs and labels "be posted at each regulated area where occupational exposures could exceed the PEL," except for the two following exempted situations for which no warning label or MSDS was required: "(1) [a]sbestos fibers have been modified by a bonding agent, coating, binder, or other material, provided that the manufacturer can demonstrate that during any reasonably foreseeable use (including handling, storage, disposal, processing, or transportation) employee exposure will remain below the action level; or (2) asbestos is present in a product in concentrations less than 0.1%" (OSHA 1986, p. 22698-22699). This labeling exemption was intended for products including brake pads and other automotive friction materials because of the encapsulated nature of asbestos in these products.

This exemption still stands today; specifically, the 1994 update to the OSHA asbestos standard stated that no label is required on products in which "[a]sbestos fibers have been modified by a bonding agent, coating, binder, or other material, provided that the manufacturer can demonstrate that, during any reasonably foreseeable use, handling, storage, disposal, processing, or transportation, no airborne concentrations of asbestos fibers in excess of the permissible exposure limit and/or excursion limit will be released, or … [a]sbestos is present in a product in concentrations less than 1.0 percent by weight" (OSHA 1994, p. 41089-41090).

As described above, encapsulated asbestos products were and still are exempt from the OSHA regulations because the airborne fiber concentrations associated with their use are not expected to exceed the OSHA asbestos exposure limits during reasonably foreseeable activities. Available literature, as discussed below, indicates that airborne concentration measurements in brake work exposure studies and industrial hygiene surveys have been consistently below contemporaneous asbestos exposure limits.

Summary

Based on the measurement data in the literature and the OSHA labeling exemptions, brakes were historically considered encapsulated under the OSHA asbestos exposure standards, and are still considered encapsulated today. Many studies of the full-shift asbestos exposure potential during the reasonably foreseeable use of these products have shown exposures to be below or well below the current OSHA 8-hour TWA PEL of 0.1 f/cc, and certainly well below the contemporaneous PELs and action levels. As a result, it would have been reasonable not to

provide OSHA warnings associated with asbestos in these products. This opinion is also consistent with the peer-reviewed literature (Kopelovich et al. 2014).

Employer Responsibility for Worker Health and Safety

It is and always has been well understood that employers are responsible for the safety and well-being of their employees, given their ultimate control over workplace practices and conditions. From old English law to today's worker compensation systems, the employer who supervises and controls the ways and means by which work is done is accountable for the safety and health of his or her employees.

The notion that the health and safety of workers is the responsibility of the employer has a long history. For example, in England, dating back to 1200 A.D., masters were held responsible for the safety of their servants under the law of King Henry I in the 11^{th} and 12^{th} century (Henshaw et al. 2007). However, it was not until rapid industrialization in the United States and elsewhere during the late 1800s and early 1900s, when urban workplaces became more complicated and crowded, that new and unfamiliar workplace hazards highlighted the need for regulatory action regarding workplace health and safety (Henshaw et al. 2007). The need for occupational health and safety oversight, as well as employer accountability for worker well-being, became evident following a number of catastrophic industrial accidents, such as the 1911 Triangle Shirtwaist fire in New York (Henshaw et al. 2007; MacLaury n.d.). The earliest legislation on workplace safety in the United States was state-specific, beginning with Massachusetts' factory safety and health law passed in 1877. Most states followed with their own occupational and health legislation by 1920 (Henshaw et al. 2007; MacLaury n.d.).

On the federal level, workers' compensation laws represented some of the earliest efforts to hold employers accountable for at least the financial burden of workplace injury and loss of life, with an underlying understanding that employers would be motivated to protect against these outcomes. The Federal Employers' Liability Act (FELA) was passed in 1907, specifically to compensate railroad workers for work-related injuries. Many states followed suit, and passed workmen's compensation legislation (Henshaw et al. 2007).

In 1913, the US Department of Labor (DOL) was established to address health and safety concerns associated with a changing and growing workforce (Henshaw et al. 2007). The DOL published the "Safety Code for the Protection of Industrial Workers in Foundries," which described the responsibility of the employer to provide appropriate personal protective equipment to its

employees. Additionally, The Walsh-Healey Public Contracts Act was signed into law in 1936 to provide protections for those employed with contractors engaged in the manufacture or supply of materials for the United States government under the authority of the DOL (U.S. Department of Labor 1936). Although the law was specific to government contractors, the regulation provided a framework for making employers responsible for the health and safety of its workers (U.S. Department of Labor 1952). According to the Walsh Healey Basic Safety Health Requirements reported in 1942, it was "the duty of the employer" to provide employees "effective suitable protective equipment" to protect the eyes and face from hazards, including dusts (U.S. Department of Labor 1942, p. 6). Further, the requirement included that the employer provide personal respiratory protective equipment approved by the U.S. Bureau of Mines "for the particular health hazard involved" (U.S. Department of Labor 1942, p. 8). It was specified that such respiratory protective equipment be "maintained by the employer at no cost to the employee" (U.S. Department of Labor 1942, p. 8).

The National Bureau of Standards within the US Department of Commerce was formed in 1901 as an authoritative body on US measurements and standards. In 1938, the National Bureau of Standards convened a group consisting of industry and government representatives and published the "American Standard Safety Code for the Protection of Heads, Eyes, and Respiratory Organs," which details the responsibility of employers to provide personal protective equipment, including respiratory protection, to its employees based on recognized hazards (NBS (National Bureau of Standards) 1938).

Employer Responsibility in the OSHA Era (December 1970 – Present)

The single most important event in American history for workplace safety and health was the passage of the Occupational Safety and Health Act in 1970. With over 90 million workers in America at that time, Congress made the duties and responsibilities of the employer clear by stating in Section 5 of the Act: "(a) Each employer – (1) shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees; (2) shall comply with occupational safety and health standards promulgated under this Act" (United States 91st Congress 1970). Further, the 1972 OSHA asbestos standard specified that "every employer shall cause very place of employment where asbestos fibers are released to be monitored in such a way as to determine whether every employee's exposure to asbestos fibers" was below applicable limits (OSHA 1972b: p. 11321). However, the expectations for the employer to protect workers against foreseeable workplace hazards has been in place long before this Act (Henshaw

et al. 2007). During the expansion of American industry between 1950 and 1969, professional industrial hygiene associations, such as the ACGIH, were active in the establishment of OELs and other recommended practices for industry. In addition, many employers established their own industrial hygiene departments to improve health and safety programs based upon the voluntary guidance for industry. The federal government, including the Department of Labor, also adopted many of the voluntary standards and work practices for government contractors with requirements that held the employer accountable for worker safety and health (U.S. Department of Labor 1952; Department of Labor 1960).

Two executive orders issued in the early 1970s expanded the provisions of the Occupational Safety and Health Act of 1970 to apply to federal government employees in addition to private sector employees (Peters et al. n.d.-a, n.d.-b). On July 26, 1971, President Richard Nixon signed Executive Order 11612 entitled "Establishment of Occupational Safety and Health Programs in Federal Departments and Agencies" (Peters et al. n.d.-b). This order directed the head of each Federal department and agency to establish an occupational safety and health program in compliance with the Occupational Safety and Health Act of 1970. On September 28, 1974, Present Gerald Ford enacted Executive Order 11807 which replaced Executive Order 11612 (Peters et al. n.d.-a). Executive Order 11807 expanded on the directives contained within Executive Order 11612 in order to improve the effectiveness of each federal agency's Occupational Safety and Health Program. The expanded directives included a directive that the Secretary of Labor issue "detailed guidelines to assist agencies in establishing and operating effective occupational safety and health programs" (Peters et al. n.d.-a, p. 4).

OSHA has continued to reinforce the importance of employer responsibility since the 1970s. In 1991, OSHA published a letter of interpretation that stated, "The primary determination of responsibility for occupational safety and health purposes is which employer directly supervises the employee's day to day work activities and thereby directs the details, means, methods, and processes by which the employee reaches the work objective" (OSHA (Occupational Safety and Health Administration) 1991). Similarly, in 1998, the Occupational Safety and Health Review Commission (a federally appointed panel whose job is to adjudicate OSHA citations) ruled in a case of a subcontractor vs. general contractor: "Each employer is bound by this Act to look out for the safety of his own employees … Contractual agreements between an employer and another party, stipulating that one party will be solely responsible for the safety of the other's employees, will not negate the original employer's obligation under the Act and does not constitute a defense to a citation" (Rothstein 1998).

The Industrial Hygiene Hierarchy of Controls

The Walsh Healey Basic Safety Health Requirements of 1942 outlined the hierarchy of controls that applied to public contracts. The requirements state that employers “shall have provision for adequate ventilation” for all work rooms, buildings, and places of employment. Additionally, the Walsh Healey Act required that “harmful atmospheric contaminants,” including dusts, “shall be reduced or otherwise controlled at the point of origin, by local exhaust” to prevent these materials from entering the breathing zone of workers (U.S. Department of Labor 1942, p. 8). Only in the event that ventilation and local exhaust were “impracticable,” employers were to enclose or isolate the work space where the “harmful contaminants” were produced, and any workers entering the enclosed work space were to “be provided with and required to wear suitable type U.S. Bureau of Mines approved respirators or masks when exposed to the harmful contaminants” workers (U.S. Department of Labor 1942, 8). The Walsh-Healey Act allowed for the use of various controls including substitution of the harmful contaminant with a less toxic material, exhaust ventilation, isolation or enclosure of the operations producing the contaminant, process changes, and increased general ventilation (U.S. Department of Labor 1952, p. 23).

The asbestos standard promulgated by OSHA required that administrative or engineering controls be implemented to achieve compliance, when feasible. Personal protective equipment was to be considered when other measures to control exposure were not feasible or possible. OSHA stated that when protective equipment was used as the method to protect employees from exposure, “such protection must be approved for each specific application by a competent industrial hygienist or other technically qualified source” (OSHA 1971b, p. 10504).

<u>National Respiratory Protection Regulations and Standards</u>

Timeline of Key Events

Date	**Agency and Topic**	**Event**
1959	ASA, Respiratory Protection	American Standards Association approved Z2.1-1959, the American Standard Safety Code for Head, Eye, and Respiratory Protection (American Standards Association 1959)
1969	ANSI, Respiratory Protection	American National Standards Institute, Inc. (ANSI) approved ANSI Z88.2-1969, the American National Standard Practices for Respiratory Protection (ANSI 1969)

1971, May	OSHA, Respiratory Protection	OSHA's Respiratory Protection Standard, 19 CFR 1910.134 was adopted (OSHA 1972a, p. 119-120, 359; 1982, p. 20804)
1971, May	OSHA, Asbestos	OSHA promulgated regulatory requirements for asbestos, 29 CFR 1910.03 (OSHA 1971b, 10503-10506)
1971, Dec.	OSHA, Asbestos	OSHA published the emergency standard for exposure to asbestos dust, 29 CFR 1910.93a (OSHA 1971a, p. 23207-23208)
1972	OSHA, Asbestos	OSHA published the permanent standard for exposure to asbestos dust, 29 CFR 1910.93a (OSHA 1972b, p. 11318-11320)
1980	ANSI, Respiratory Protection	ANSI approved ANSI Z88.2-1980, an updated American National Standard Practices for Respiratory Protection (ANSI 1980)
1986	OSHA, Asbestos	OSHA published an updated standard for exposure to asbestos dust, 29 CFR 1910.93a (OSHA 1986)
1992	ANSI, Respiratory Protection	ANSI approved ANSI Z88.2-1992, an updated American National Standard for Respiratory Protection (ANSI 1992)
1994	OSHA, Asbestos	OSHA published an updated standard for exposure to asbestos dust (OSHA 1994)
1998	OSHA, Respiratory Protection	OSHA issued its final revised respiratory protection regulation (OSHA 1998a)
2006	OSHA, Respiratory Protection	OSHA published legally enforceable Assigned Protection Factors (APFs) for respirators (OSHA 2006)
2015	ANSI/ASSE, Respiratory Protection	ANSI and the American Society of Safety Engineers (ASSE) adopted ANSI/ASSE Z88.2-2015 Practices for Respiratory Protection (ASSE 2017)

American Standard Safety/American National Standards Institute (ASA/ANSI) Respirator Standards

- Z2.1-1959 American Standard Safety Code for Head, Eye, and Respiratory Protection

In 1959, the American Standards Association approved Z2.1-1959, the American Standard Safety Code for Head, Eye, and Respiratory Protection (American Standards Association 1959). The document was a consensus document with voluntary compliance. The Z2.1-1959 standard was a revision of the 1938 version of the standard which was published as part of the National Bureau of Standards Handbook H24 (American Standards Association 1959). It was the 1938 version of the standard that first included respiratory protection (American Standards Association 1959).

Regarding particulates, the standard classifies particulate air contaminants as: 1) toxic particulates that pass into the blood stream, or 2) fibrosis-producing dust such as asbestos, or 3) nontoxic and nonfibrosis-producing particulates (American Standards Association 1959, p. 28).

The Z2.1-1959 standard advised that respirators should be selected based on eight key factors: 1) the nature of the hazard (e.g. particulate vs. gaseous); 2) the severity of the hazard; 3) the type of contaminant; 4) the concentration of the contaminant; 5) the period of required respiratory protection; 6) location of the contaminated air with respect to source of respirable air; 7) activity of the wearer; and 8) the operating characteristics and limitations of the available respirators (American Standards Association 1959, p. 33-36).

The Z2.1-1959 standard stated that respirators were used to supplement other methods of control rather than to substitute for them (American Standards Association 1959, p. 36). The standard explained that respirators may be called for until other control measures can be put into place or in scenarios where other control measures are impracticable.

According to Z2.1-1959, "it is essential that the user be properly instructed in [respirator] selection, use, and maintenance" (American Standards Association 1959, p. 39). The standard stated that "[c]ompetent persons should give such instruction to the supervisors of all groups who may be required to wear respirators" and the "supervisors, in turn, should instruct their men" (American Standards Association 1959, p. 39). The standard explained that the training should include: 1) an explanation of why the respirator is needed, 2) the respirator's operating principle, 3) how to ensure the respirator is in good operating condition, 4) how to properly adjust the respirator, 5) how to properly use and maintain the respirator.

- ANSI Z88.2-1969 American National Standard Practices for Respiratory Protection

In 1969, the American National Standards Institute, Inc., (ANSI) approved ANSI Z88.2-1969, the American National Standard Practices for Respiratory Protection (ANSI 1969). The document was a consensus document with voluntary compliance. AINSI Z88.2-1969 was a revision of the respiratory protection portion of the American Safety Standard Code for Head, Eye, and Respiratory Protection, Z2.1-1959. In revision of Z2.1-1959, it was deemed advisable to separate the portion on respiratory protection into its own separate standard. Unlike Z2.1-1959, AINSI Z88.2-1969 added a section entitled "Recommended Requirements for Codes" for authorities considering establishment of respirator regulations or codes (ANSI 1969).

In the introduction of the AINSI Z88.2-1969 standard, it is stated that “exposure control shall be accomplished as far as is feasible by accepted engineering control methods before considering or instituting the use of respirators” (ANSI 1969, p. 7). Under the section, “Recommended Requirements for Codes”, the AINSI Z88.2-1969 standard stated “In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, *the primary objective shall be to prevent atmospheric contamination*” (ANSI 1969, p. 9, italics in original text).

The ANSI Z88.2-1969 standard stated that According to the ANSI Z88.2-1969 standard, minimum training shall include: 1) instruction in the nature of the hazard; 2) explanation of why more positive control is not immediately feasible; 3) a discussion of why this is the proper type of respirator for the particular purpose; 4) a discussion of the respirator’s capabilities and limitations; 5) instruction and training in actual use of the respirator; 6) classroom and field training; and 7) other special training as needed (ANSI 1969, p. 24). As was indicated in the Z2.1-1959 standard, the ANSI Z88.2-1969 standard stated that both “supervisors and workers shall be instructed by competent persons” (ANSI 1969, p. 24).

In the section of the ANSI Z88.2-1969 standard entitled “Recommended Requirements for Codes”, the standard stated that employers shall provide respirators to employees when such equipment is necessary to protect the health of the employee. The standard specified that the employer shall provide the respirators which are applicable and suitable for the purposed intended. Further, the standard stated that the employer shall be responsible for the establishment and maintenance of a respiratory protective program. The standard stated that the minimal acceptable respiratory protective program shall include the following: 1) written standard operating procedures governing the selection and use of respirators; 2) respirators shall be selected on the basis of the hazards to which the worker is exposed; 3) the user shall be instructed and trained in the proper use of the respirators and their limitations; 4) where practicable, respirators should be assigned to individual workers for their exclusive use; 5) respirators shall be regularly cleaned and disinfected; 6) respirators shall be stored in a convenient, clean, and sanitary location; 7) respirators shall be inspected during cleaning or, for emergency use respirators, at least once per month and after each use; 8) the employer shall maintain appropriate surveillance of the work area conditions and the degree of employee exposure or stress; and, 9) the employer shall regularly inspect and evaluate to determine the continued effectiveness of the program (ANSI 1969, p. 9).

Regarding administration of the respiratory protection program, the ANSI Z88.2-1969 standard stated that the program shall be administered by the plant or company industrial hygiene, health physics, safety engineering, or fire department ,or, in the absence of any such department, by an upper-level superintendent, foreman, or other qualified individual responsible to the principle manager. The standard stated that responsibility for the program shall be vested in one individual (ANSI 1969).

According to ANSI Z88.2-1969, the respirator furnished by the employer shall provide adequate respiratory protection against the particular hazard for which it is designed in accordance with standards established by competent authorities (ANSI 1969, p. 11). The ANSI Z88.2-1969 stated that the correct respirator shall be specified for each job, adding that "[t]he respirator type is usually specified in the work procedures by a qualified individual supervising the respiratory protective program" (ANSI 1969, p. 23). According to the ANSI Z88.2-1969 standard, "[f]requent random inspections shall be conducted by a qualified individual to assure that respirators are properly selected, used, cleaned, and maintained" (ANSI 1969, p. 28).

- ANSI Z88.2-1980: American National Standard Practices for Respiratory Protection

ANSI approved Z88.2-1980, an updated Practices for Respiratory Protection, in May 1980 (ANSI 1980). The ANSI Z88.2-1980 standard was a voluntary consensus standard.

According to Table 5 of ANSI Z88.2-1980, particulate-filter, quarter-mask or half-mask facepiece filters provide a respirator protection factor of 10 based on qualitative testing, or a factor of up to 100 based on quantitative test measurements on each person (ANSI 1980).

- ANSI Z88.2-1992

ANSI approved Z88.2-1992, an updated American National Standard for Respiratory Protection, in August 1992 (ANSI 1992). The ANSI Z88.2-1992 standard was a voluntary consensus standard. According to Table 1 of the ANSI Z88.2-1992 standard, the assigned protection factor of air-purifying half mask respirators was 10 (ANSI 1992).

- ANSI/ASSE Z88.2-2015 Practices for Respiratory Protection

In 2015, ANSI and the American Society of Safety Engineers (ASSE) approved ANSI/ASSE Z88.2-2015, Practices for Respiratory Protection (ASSE 2017). The updated standard incorporates

regulatory and national standards changes that have occurred since the adoption of ANSI Z88.2-1992.

Early OSHA Respiratory Protection Standards

- OSHA 1971 – 29 CFR 1910.134

In May 1971, the newly formed OSHA adopted its Respiratory Protection Standard, 29 CFR 1910.134 (OSHA 1972a, p. 119-120, 359; 1982, p. 20804). The 29 CFR 1910.134-1971 standard was adopted from the ANSI Z88.2-1969 voluntary consensus standard (OSHA 1982, p. 20804).

As was stated in the Z88.2-1969 standard, the 29 CFR 1910.134-1971 standard stated that "In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination" (OSHA 1972a, p. 359). Also as was stated in the Z88.2-1969 standard, the 29 CFR 1910.134-1971 standard stated that prevention of atmospheric contamination "shall be accomplished as far as is feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials)" (OSHA 1972a, p. 359).

As was stated in the ANSI 1969 standard and the Z2.1-1959 standard, the 29 CFR 1910.134-1971 standard stated that is essential that the user be properly instructed in respirator selection, use, and maintenance (OSHA 1972a, p. 361). Likewise, it was stated that both supervisors and workers shall be instructed by competent persons (OSHA 1972a, p. 361).

The text of the 29 CFR 1910.134-1971 standard began with the text from the Section 3 of the Z88.2-1969 standard, "Recommended Requirements for Codes", including the sections regarding employer responsibility and the minimal acceptable respiratory protection program (OSHA 1972a, p. 359; ANSI 1969). The 29 CFR 1910.134-1971 standard contains the same text regarding employer responsibility within the Z88.2-1969 standard.

In addition, in the section about general requirements for personal protective equipment (1910.132), OSHA stated that personal protective devices including respiratory devices shall be "provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in any part

of the body through … inhalation" (OSHA 1972a, p. 358-359). Further, OSHA stated that "[w]here employees provide their own protective equipment, the employer shall be responsible to assure its adequacy, including proper maintenance, and sanitation of such equipment (OSHA 1972a, p. 359).

Early Provisions of OSHA Asbestos Standards Regarding Respiratory Protection

- OSHA 1971, May – 29 CFR 1910.93

In May of 1971, OSHA published 29 CFR 1910.93, Air contaminants (Gases, vapors, fumes, dust, and mists) in which OSHA promulgated the first legally binding regulatory exposure limit for asbestos (OSHA 1971b, p. 10503-10506).

The 29 CFR 1910.93-May 2971 standard stated that, to achieve compliance with the exposure limit, "feasible administrative or engineering controls must first be determined and implemented in all cases" (OSHA 1971b, p. 10504). The 29 CFR 1910.93-May 2971 standard also stated that in cases "where protective equipment, or protective equipment in addition to other measures is used as the method of protecting the employee, such protection must be approved for each specific application by a competent industrial hygienist or other technically qualified source" (OSHA 1971b, p. 10504).

- OSHA 1971, December – 29 CFR 1910.93a

In December 1971, OSHA published 29 CFR 1910.93a as an emergency standard for asbestos dust (OSHA 1971a, p. 23207-23208). In the standard, OSHA stated that the employer shall establish a respirator program in accordance with the requirements of ANSI Z88.2-1969 (OSHA 1971a, p. 23208). According to the 29 CFR 1910.93a-Dec 1971 standard, the respirators provided by employers to each employee shall be properly inspected, cleaned, repaired and stored (OSHA 1971a, p. 23208).

According to the 29 CFR 1910.93a-Dec 1971 standard, employers shall provide respirators that are approved by the US Bureau of Mines under the provisions of 30 CFR Part 14 (Bureau of Mines Schedule 21B) (OSHA 1971a, p. 23208). OSHA stated in the 29 CFR 1910.93a-Dec 1971 standard, that, for 8-hr TWA exposure concentrations not exceeding 25 f/cc, and 15-minute TWA concentrations not exceeding 50 f/cc, "a reusable or single-use filter type respirator, operating with negative pressure during the inhalation phase of breathing, approved by the US Bureau of

Mines …, or a valveless respirator providing equivalent protection, shall be used" (OSHA 1971a, p. 23208). For 8-hr TWA exposure concentrations not exceeding 250 f/cc, and 15-minute TWA concentrations not exceeding 500 f/cc, "a powered filter positive pressure respirator approved by the US Bureau of Mines … shall be used" (OSHA 1971a, p. 23208). For 8-hr TWA exposure concentrations exceeding 250 f/cc, "a type C positive pressure supplied-air respirator approved by the US Bureau of Mines … shall be used" (OSHA 1971a, p. 23208).

According to the 29 CFR 1910.93a-Dec 1971 standard, "[e]ngineering methods, such as but not limited to, enclosure, vacuum sweeping, and local exhaust ventilation, shall be used to meet the exposure limits … of this section. Where such engineering methods are not feasible, or do not otherwise reduce the concentrations below those prescribed …, respiratory protective devices shall be provided and used in accordance with paragraph (c) of this section." (OSHA 1971a, p. 23208).

- OSHA 1972, 29 CFR 1910.93a

In June of 1972, OSHA published an updated 29 CFR 1910.93a as a permanent standard for asbestos dust (OSHA 1972b, p. 11318-11320). According to the 29 CFR 1910.93a-1972 standard, the employer shall establish a respirator program in accordance with the requirements of ANSI Z88.2-1969 (OSHA 1972b, p. 11320-11321). OSHA stated in its 29 CFR 1910.93a-1972 standard that employers are required, within 6 months of the publishing of the standard, to perform personal and environmental monitoring to determine the 8-hr TWA and ceiling fiber concentrations of employees (OSHA 1972b, p. 11321). For employees whose asbestos exposures were reasonably foreseen to exceed the exposure limits, employers were required to perform personal monitoring at least every six months (OSHA 1972b, p. 11321).

In the 29 CFR 1910.93a-1972 standard, OSHA required that employers select respirators that were approved by the Bureau of Mines or by NIOSH under the provisions of 30 CFR Part 11 (OSHA 1972b, p. 11320).

In the 29 CFR 1910.93a-1972 standard, OSHA stated that compliance with asbestos exposure limits shall be met using engineering controls, local exhaust ventilation, particular tools, and work practices such as wet methods (OSHA 1972b, p. 11320). OSHA stated that compliance shall not be achieved using respirators or shift rotation of employees except during the time period necessary to install the engineering controls and institute appropriate work practices, and in

which other controls are either technically not feasible or are insufficient to reduce the airborne concentrations below the exposure limits (OSHA 1972b, p. 11320).

OSHA Respirator Assigned Protection Factors

In 2006, OSHA revised its respiratory protection standard to add definitions and requirements for assigned protection factors (APFs) and maximum use concentrations (MUCs) (OSHA 2006). ANSI standard Z88.2-1969 which was adopted by OSHA in 1971 did not contain APFs for respirator selection (OSHA 2006, p. 50125). In the 1998 final respiratory protection standard, OSHA reserved the sections related to APFs and MUCs pending further rulemaking. In the interim, OSHA stated that employers should take into account the best available information when selecting respirators, including the APFs in the 1987 NIOSH Respirator Decision Logic (RDL) document (OSHA 2006, p. 50125). In 2006, OSHA determined that the class of respirators which included the 3M 8710 would have an APF of 10; NIOSH agreed with OSHA's determination that this class of respirators would have an APF of 10 [see Section IV(C)2].

Industrial Hygiene Knowledge Over Time Regarding Asbestos

With several colleagues, I published a review article regarding the knowledge of asbestos over time within the industrial hygiene community from the early 1900s until the advent of the national health and safety regulatory structure currently in place in the U.S. (early-to-mid 1970s) (Barlow et al. 2017). Following our review of over 1,000 references, it was apparent that the evaluation of the health risks of asbestos was a complex evolution requiring decades of focused research, particularly with respect to exposure assessment (Barlow et al. 2017). Developments over time specifically as they relate to industrial hygiene knowledge of asbestos, asbestos exposure limits (1930s-1970s), and the establishment of U.S. OSHA and NIOSH are discussed in detail in the sections below.

Developments in Industrial Hygiene Knowledge of Asbestos

Industrial hygiene as a profession was in its infancy when asbestos use increased substantially in the early 1900s (Barlow et al. 2017). In this early 1900s timeframe, asbestos was frequently used in the heavy machinery industry, in the building and insulation trades, and in the military. Examples of important uses included in heat-resistant equipment components such as gaskets and brakes; in fire- and heat-resistant building components and piping systems; and for fire protection and insulation on ships. Over time, asbestos has been used in various commercial and

household products such as pipe insulation, fireproof roofing and wall materials, textiles including rope, twine, and yarn, electrical applications, plastics, flooring, paints, plasters, caulks, asphalt, mattresses, theater curtains, medical equipment, baking sheets, and cabinets (Virta 2005; Selikoff et al. 1978). Further, given the heat-resistant properties of asbestos, it was used in clothing for fire and heat protection. For example, in the October 1934 issue of *Popular Science*, asbestos suits and umbrellas used by London firemen were praised as safety devices that enabled the firemen to approach the “most furious blaze” (Unknown 1934, p. 30).

It was in 1930 that very high dust exposure levels in the asbestos manufacturing trades, including mining, milling, and asbestos textile production, were definitively linked to a non-carcinogenic lung fibrosis condition that became known as asbestosis. Merewether and Price (1930) reported that greater than 25% of workers exposed to asbestos in textile manufacturing settings in the United Kingdom developed pulmonary fibrosis, and that the incidence of fibrosis increased with the length of employment. Before 1930, the technology to measure worker exposures was very limited, and therefore restricted the ability of public health professionals to draw conclusions about the relationship between asbestos exposure and health risk (Barlow et al. 2017).

From the 1930s through the 1950s, the vast majority of published studies on asbestos looked at workplace conditions in very dusty asbestos manufacturing settings in which raw asbestos was used. According to Merewether and Price in their 1930 study, their investigation focused on manufacturing “in which there [was] exposure to pure asbestos or asbestos mixed with a very small percentage of cotton or other vegetable fibre” (Merewether et al. 1930). In 1935, a British report entitled “Memorandum of the Industrial Diseases of Silicosis and Asbestosis” identified the manufacturing of asbestos textiles, the making or repairing of insulating slabs and mattresses, and the sawing, grinding, and turning of articles composed wholly or partly of dry asbestos as the industries and processes where asbestosis was likely to occur (Home Office 1935).

From the 1940s through the 1960s, Naval specifications required that amosite asbestos-containing insulation be used for a variety of applications on ships (U.S. Navy 1959b, 1962, 1947). In 1942, the U.S. Navy issued a conservation order to conserve the supply of asbestos for purposes of national defense, mandating “no person shall fabricate, spin, or process in any other way asbestos fibre … except where such fabrication, spinning or processing is necessary to fill Defense Orders” (Knowlson 1942, p. 436). Chapter 39 of the Bureau of Ships Manual of 1945 describes a number of shipboard applications requiring different types of thermal insulation and lagging. This manual described specifications for asbestos-containing materials for insulation applications based on equipment and temperature considerations (U.S. Navy 1945). Later

revisions of this manual, through at least 1966, maintained specifications for asbestos-containing materials in certain applications (U.S. Navy 1947, 1959a, 1960, 1965, 1966).

Through the 1950s, the ASTM International (formerly known as the American Society for Testing and Materials) had a number of asbestos-product related standards in place. The ASTM is a non-profit organization formed in 1898 to develop international voluntary consensus standards to improve product quality and enhance safety. Standards related to asbestos products included the manufacture of asbestos yarns, asbestos roving for electrical purposes, asbestos tubular sleeving, asphalt-saturated asbestos felts, laminated asbestos thermal insulation, and cellular asbestos paper thermal insulation (ASTM 299-52T; 375-52; 577-52; 628-52; 250-56; C298-56; C299-56) (ASTM 1952a, 1952b, 1952d, 1952c, 1956b, 1956a, 1956c).

In the early 1950s, the first studies began to be formally published about the nature of the fibrosis reaction caused by asbestos in the lungs. According to Vorwald et al. (1951), experiments on fiber dimension yielded information that “the capacity of inhaled asbestos fibers to produce fibrosis [was] determined primarily by factors not chemical in nature” but rather by mechanical factors (Vorwald et al. 1951, p. 18). The authors reported that fibers shorter than about 10 to 20 µm in length were “relatively innocuous” and that fibrosis was primarily caused by fibers in the range of 20 to 50 µm in length (Vorwald et al. 1951, p. 40). It was also reported that when asbestos was ground up so that none of the particles were longer than 20 µm in length, “the fibrosis –producing character of asbestos could be almost eliminated” (Sander 1958, p. 398). The American College of Chest Physicians also noted in 1964 that “grinding the fibers to less than 5 microns in length decreases their capacity to evoke fibrosis in experimental animals” (Hannon et al. 1964, p. 108).

In 1952, it was noted by Dr. Smith that, “It was the consensus of Dr. Gloyne, Dr. Wyers and Dr. Merewether that the nature of the disease asbestosis in England has changed so that it is less common and less severe in individuals whose employment in the industry has taken place only since 1932 [the year when exhaust ventilation devices were installed]. It was the consensus that a lung tumor hazard formerly existed in this industry in Great Britain but that there is no evidence to show that such a hazard continues to exist under the working conditions now prevailing” (Smith 1952, p. 253).

It was in the mid-1950s that the link between asbestos exposure and cancer was formally investigated within the advancing field of epidemiological research (Eckardt et al. 1954). Although there were a number of case reports in the late 1940s and early 1950s about a potential relationship between lung cancer and exposure to asbestos, the interpretation of these case

reports was complicated by the fact that most workers were also smokers (Merewether 1949). Thus, while there was some concern that asbestos alone might cause lung cancer, the data were not convincing through the early 1950s.

In 1955, Sir Richard Doll used a robust epidemiological study design to examine the association between asbestosis and lung cancer in workers in the United Kingdom exposed to elevated asbestos dust for twenty years or more in the asbestos textile industry. His study results indicated that an association between asbestosis and lung cancer existed. Because nearly all of the lung cancer cases that Doll studied were also diagnosed with asbestosis, he believed that asbestosis was a precursor to lung cancer and therefore lung cancer was similarly associated with high levels of asbestos exposure (Doll 1955). Doll concluded that the risk of developing asbestosis and lung cancer should continue to diminish as the industrial hygiene controls suggested by Merewether and Price (1930) were adopted (Doll 1955). Other scientists studying the asbestos-lung cancer association at the time agreed that asbestosis was a necessary precursor of lung cancer. According to Hueper, the Chief of the Environmental Cancer Section of the National Cancer Institute in 1955, "[e]pidemiological data available at present indicate that an increased liability to cancer is limited to the presence of asbestosis of the lung and does not extend to exposure to asbestos without the existence of a pneumoconiosis resulting therefrom" (Hueper 1955). Hueper confirmed in 1957 his belief that the risk of lung cancer was associated with those who were highest exposed, stating that an increased risk of lung cancer existed for miners, textile workers, and brake lining manufacturers (Hueper 1957).

It should be noted that through the 1950s and early 1960s, the industrial hygiene and safety community did not yet fully embrace the association between asbestos exposure and lung cancer. In the second edition of the Patty's Industrial Hygiene and Toxicology textbook in 1958, the section of the book written by Sander about asbestos was referred to as "Asbestosis," and in this section it was noted that "lung cancer is under suspicion as occurring more frequently with asbestosis, especially in England" (Sander 1958, p. 398). Similarly, in 1963, the National Safety Council Data Sheet #531 stated that "[i]t is suspected that lung cancer may be induced by asbestos. However, there is no impressive amount of evidence to support this assumption" (National Safety Council 1963). That same year, the Council on Occupational Health of the American Medical Association voiced a similar opinion (Robin et al. 1963). In 1964, the American College of Chest Physicians stated that "While it has been reported that there may be an enhanced prevalence of pulmonary neoplasia in some asbestos industries (e.g. crocidolite or amosite), or in some locations (e.g. South Africa, England), this does not appear to apply for the

chrysotile industry in North America. This comment applies both with respect to intrapulmonary new growths and to pleural mesothelioma" (Hannon et al. 1964, p. 109).

In addition to the causal association between asbestosis and lung cancer demonstrated by Doll in 1955, research was first published in the early 1960s reporting mesothelioma after crocidolite exposure. In 1960, Wagner et al. found that increased mesothelioma risk was associated with exposure to crocidolite, an amphibole mineral fiber (Wagner et al. 1960). In a follow up study in 1965, Wagner examined populations who lived or worked near crocidolite, amosite, and chrysotile mines or were occupationally exposed via mining or other work in South Africa. While numerous cases of mesothelioma were identified in populations near crocidolite mines, no cases were associated with chrysotile or amosite mines (Wagner 1965).

In October 1964, Dr. Irving Selikoff, a researcher at Mt. Sinai Hospital in New York City, held a conference on the "Biological Effects of Asbestos." The proceedings of this conference were published in late 1965. A notable study discussed at the conference was Dr. Selikoff's report examining a cohort of more than 600 insulation workers that primarily handled amosite-containing insulation (Selikoff et al. 1964, 1965a). This study found a significantly increased risk of death from lung cancer and mesothelioma among insulation workers, a finding that resulted in a key change in the way future asbestos worker studies were conducted, and researchers began to investigate worker cohorts handling other asbestos-containing end-user products.

The debate over the association between asbestos and cancer (both lung cancer and mesothelioma) lasted over many decades. Enterline extensively reviewed the literature from between 1935 and 1965 on these associations (Enterline 1991). Opinions on the likelihood of association were different depending on the country of research origin, and significantly different degrees of association were seen by different researchers. In Europe and Africa, there were more consistent and significant associations noted for both lung cancer and mesothelioma, most likely due to fiber type differences (Enterline 1991; Wagner et al. 1960; Doll 1955; Wedler 1943b, 1943a; Braun et al. 1958; Gilson 1965; Nordmann 1938).

In 1969, the first edition of the Insulation Hygiene Progress Reports appeared in the Asbestos Worker journal of the International Association of Heat and Frost Insulators and Asbestos Workers union. These reports provided updates on the Insulation Industry Hygiene Research Program, which represented "the nation's first cooperative effort by an international labor union, industry, and science, consulting with government to undertake a health research program for industrial workers" (Selikoff 1969: no. 1, p. 1). Dr. Selikoff was the director of the program in a

joint agreement with the Mt. Sinai Environmental Sciences Laboratory. According to the first report, published in the spring of 1969, "the primary purpose of the combined industrial hygiene and preventive engineering research program [was] to develop improved methods that will minimize exposure of insulation workers to dust and fumes encountered in their jobs" (Asbestos Worker Journal 1969-1972, no. 1, p. 1). Key initiatives of the program included developing a new respirator for insulation workers that was "efficient, comfortable, and disposable," sprayed fiber controls, "dustless [insulation] mixing bags," and development of effective dust collectors for mechanized equipment such as band saws or textile saws (Asbestos Worker Journal 1969-1972, no.1, p. 1, no. 3, p. 1).

Developments in Asbestos Exposure Limits Over Time, 1930s - 1970

In 1933, Dr. E.R.A. Mereweather, the Medical Inspector of Factories in England, published an analysis in which he stated that, "from examination of the varying conditions of exposure to dust amongst 'spinners' in individual factories, it appeared reasonable to infer that the exposure of workers in this group to dust, as a whole, was not greatly in excess of the maximum safe limit" and that "the conditions arising from flyer spinning carried on without exhaust under good general conditions was considered as the safe criterion and was termed the 'dust datum'" (Merewether 1933, p. 115-116). In 1930, Merewether presented five airborne dust concentration measurements for activities characterized as asbestos "spinning" using the Owens jet apparatus. These measurements were reported in the number of particles per cubic centimeter (p/cc), ranging from 620 p/cc to 6,044 p/cc. Converting these concentrations to mppcf results in a 'dust datum' range of approximately 17.6 to 171.2 mppcf (Merewether 1930). In 1933, Merewether made the distinction between "ring spinning" and "flyer spinning", characterizing flyer spinning as less dusty and more consistent with the levels of dustiness measured for braiding and plaiting activities (Merewether 1933, p. 115). Merewether also noted that "most" of the crystalline asbestos particles collected during the airborne dust collection were "iron containing" (Merewether 1930, p. 247).

In 1934, Merewether also explained that a "conference of asbestos textile manufacturers and representatives of the Home Office" in the U.K. government was arranged to "consider these practical difficulties and the best methods which could be adopted generally for suppressing dust in manufacturing and other processes" (Merewether 1934, p. 153). Following the conference, it was decided "to set up a joint committee to consider the problem in detail and to collect all information available concerning dust suppressing methods" (Merewether 1934, p. 153). The

committee agreed on the airborne concentration standard recommended by Dr. Merewether for dust levels and stated in their conclusions that "For practical purposes, the conditions arising from flyer spinning carried on, without exhaust under good general conditions may, it seems to the Committee, be taken as the 'dust datum.'" (Merewether 1934, p. 154).

In 1938, the U.S. Surgeon General performed an important study assessing the asbestos exposure potential for more than 500 U.S. male and female textile manufacturing workers (Dreessen et al. 1938). The results of this study confirmed that the magnitude of the airborne concentration of dust and the duration of exposures were associated with the rate of asbestosis. In their exposure study, Dreessen et al. (1938) recommended maintaining an airborne exposure concentration in the workplace of 5 million particles per cubic foot (mppcf) or less. According to the authors, "[i]t would seem that if the dust concentration in asbestos factories could be kept below 5 million particles …, new cases of asbestosis probably would not appear" (Dreessen et al., 1938: p. 117).

Before 1940, there were no national standards or guidelines regarding acceptable exposures to chemicals or particulates in the workplace, including asbestos. By 1942, a number of states had developed some guidelines for the use of specific chemicals, including asbestos, but these were often targeted for selected industries (LaNier 1984; Frederick 1984). Regarding asbestos specifically, a number of states adopted the 5 mppcf maximum permissible concentration for asbestos based on Dreessen's recommendation, including California, Colorado, Massachusetts, Michigan, North Carolina, Oklahoma, Texas, and Pennsylvania, while South Carolina adopted a 15 mppcf guideline (LaNier 1984).

The National Conference of Governmental Industrial Hygienists (NCGIH) and American Industrial Hygiene Association (AIHA) were formed in 1938 and 1939, respectively. In 1946, the NCGIH changed its name to the American Conference of Governmental Industrial Hygienists (ACGIH). The AIHA and ACGIH are professional organizations with memberships consisting of industrial hygienists and other occupational and environmental health professionals. By the early 1940s, the ACGIH had formed a committee to develop and recommend occupational exposure limits to its membership for chemicals and physical agents commonly found in the workplace (Baetjer 1984). ACGIH recognized the need to support increased consistency in state and local regulatory and guidance bodies with respect to the variety of recommendations developed for the protection of workers (Stokinger 1981).

In 1946, the ACGIH adopted a value of 5 mppcf as the recommended full-shift daily exposure limit for all mineral types of asbestos based on Dreessen et al. (1938), in which they noted that

"massive exposures" to asbestos occurred (ACGIH 1968, p. 188). This eight hour TWA TLV for asbestos remained the acceptable ACGIH exposure limit through the 1950s and up until 1968 (ACGIH 2001).

Throughout the 1940s and 1950s, industrial hygienists continued to associate hazardous asbestos exposures with workers in the asbestos mining, milling, and manufacturing trades who routinely handled raw asbestos fibers (Ayer et al. 1965; ACGIH 1968; Shapiro 1970). Exposures exceeding the 5 mppcf TLV were not associated with workers handling asbestos-containing products, and this was supported by the first large-scale epidemiological study to measure the exposures to end-users of asbestos-containing products. Published in 1946, this study examined the exposure potential and health status of naval pipe covering workers at four separate shipyard locations (Fleischer et al. 1946). The authors reported that three of the 1,074 workers evaluated had developed asbestosis after employment as pipe coverers for more than 20 years. Another 48 pipe coverers who worked for more than 10 years reportedly did not develop asbestosis. Airborne dust concentrations attributable to asbestos for certain activities such as insulation layout and cutting, sewing and fabrication, cement mixing, and grinding, were reported to be less than the recommended ACGIH TLV of 5 mppcf, although total dust concentrations were found to exceed this level. Only isolated activities in the study, such as the use of a band saw to cut insulation, were reported to result in airborne asbestos concentrations above 5 mppcf. The authors noted that the asbestos exposures associated with asbestos manufacturing settings such as asbestos textile manufacturing would "differ widely" from exposures associated with the use of asbestos-containing products (such as pipe covering activities) (Fleischer et al. 1946, p. 13). They further reported that "[i]n textile plants workers usually continue at specific jobs with fairly constant dust exposures for some years, whereas the pipe coverer may rotate between shop and ship and from small to large ship compartments with a wide variation in dust exposure" (Fleischer et al. 1946, p. 13). They also indicated that the asbestos content of insulation materials could vary widely (10-95%). In their conclusions, the authors stated that, "[s]ince each of the three cases of asbestosis had worked at asbestos pipe covering in shipyards for more than 20 years, it may be concluded that such pipe covering is not a dangerous occupation" (Fleischer et al. 1946, p. 16).

In 1951, the Walsh-Healey Contracts Act was revised by the U.S. Department of Labor to adopt the ACGIH TLV for asbestos of 5 mppcf (Department of Labor 1951). The Walsh-Healey Act stated that companies that entered into contracts of over $10,000 with the federal government were required to provide a safe workplace for their employees and assure that employees were not being exposed above specific occupational guidelines (OSHA 2002). The value for asbestos of 5 mppcf was further incorporated in the 1952, 1960, and 1966 revisions of the Walsh-Healey Act

(Department of Labor 1952, 1960, 1966). The U.S. Military also adopted these early occupational exposure limits, and in 1955, the Naval Bureau of Medicine and Surgery sent a memorandum to all locations and ships stating that the Navy should adopt the TLVs established by ACGIH, including the asbestos TLV, in order to "provide guidance toward the reduction of potential health hazards encountered in the industrial environment for both military and naval civilian personnel" (United States Navy 1955, p. 1).

Throughout the 1940s and well into the 1950s and early 1960s, the safety and health community continued to remain focused on asbestos exposure potential in the very dusty trades, including miners and millers handling raw asbestos mineral fibers and workers in asbestos product manufacturing settings. Industrial hygienists continued to consider mineral fiber concentrations below 5 mppcf (the "Dreessen Standard") unlikely to present an increased risk of asbestos-related disease, and the handling of asbestos-containing end-user products was considered unlikely to produce exposures at concentrations sufficient to put workers at increased risk of developing asbestos-related disease. Similarly, in 1953, Isselbacher et al. continued to refer to the 'dust datum' level established through the work of Merewether and the U.K. committee established to determine practical standards for dust suppression as a "safe level" (Isselbacher et al. 1953).

Another early worker exposure end-user product study was published by Marr in 1964, which, unlike Fleischer et al., 1946, demonstrated that exposures to insulators could exceed the 5 mppcf standard (Marr 1964). During a variety of insulation installation and removal tasks at Long Beach Naval Shipyard, Marr found concentrations of fibers 3-60 µm in length ranging from less than 1 mppcf to 8.0 mppcf (Marr 1964).

Despite the recent publications in the scientific literature about the association between asbestos and lung cancer and mesothelioma, in the early 1960s, the ACGIH reaffirmed the TLV for asbestos at 5 mppcf (LaNier 1984). However, a call to lower the TLV began at the Biological Effects of Asbestos conference in 1964.

Up until the mid-1960s, impingers and midget impingers were the most common sampling methods used to collect asbestos dust in the air in the U.S. In 1969, the Bureau of Occupational Safety and Health within the U.S. Department of Health, Education, and Welfare published a document on the procedure for using the Millipore sampling method for measuring airborne asbestos fiber concentration (Bayer et al. 1969). The British Asbestos Research Council published a similar method in the same year. These sampling methods collected fibers in the air on a

membrane filter, which allowed for the analysis of airborne fibers specifically, rather than just the concentrations of all particulates collected from the air (OSHA 1997; Ayer et al. 1965; Bayer et al. 1969; Barlow et al. 2017). This was an important development in assessing asbestos exposures in the workplace, since it had been established that it was the longer fibers that were of greatest concern in determining disease risk (Vorwald et al. 1951).

Despite the limitations of the impinger sampling method for asbestos, asbestos exposure measurement data collected using the impinger still generally correlated with much of the epidemiological data collected prior to this period of history. According to Ayer et al. (1965), “the incidence and severity of asbestosis increased with increasing dust exposure and … those workers exposed to dust concentrations of less than 5... mppcf [using the standard impinger method] did not develop asbestosis even after long-continued exposure” (Ayer et al. 1965, p. 274). According to worksite studies, it was determined that 1 mppcf using the impinger method was roughly equivalent to 6 fibers per milliliter of air, or f/mL (also equivalent to f/cubic centimeter, f/cc) when counting fibers greater than 5µm in length using the membrane filter method; therefore, the 5 mppcf exposure limit determined by the impinger method was roughly equivalent to 30 f/cc using the membrane filter method (Ayer et al. 1965; Lynch et al. 1968). However, this conversion factor will be variable depending upon the worksite and the nature of materials used (Ayer et al. 1965).

In 1968, the committee on Hygienic Standards of the British Occupational Hygiene Society (BOHS) first recommended a limit for chrysotile of 2 f/ml as an 8-hour TWA exposure limit (ACGIH 1968). This level was set based on a 50-year working lifetime exposure, and was derived based on the concept that in order to avoid asbestosis, the chrysotile asbestos fiber burden should be below 100 fiber/ml-years. Fiber/ml-years are calculated by multiplying the eight-hour TWA exposure by the number of years exposed, assuming exposures occur five days a week, 50 weeks a year. Also in 1968, the ACGIH proposed to change their asbestos TLV and recommended a new ceiling limit of 5 mppcf and an eight-hour TWA TLV of 2 mppcf or 12 f/cc for fibers greater than 5 µm in length. This proposed change was adopted under the Walsh-Healey Act revision of 1969. Again in 1970, ACGIH proposed to lower the TWA TLV to 5 f/cc for fibers longer than 5 µm in length, and added a short-term exposure limit of 10 f/cc, longer than 5 µm in length, as averaged over 15 minutes. ACGIH ultimately adopted the lower TWA TLV for asbestos in 1974 at 5 f/cc greater than 5µm in length and included the designation “human carcinogens ... with an assigned TLV” (ACGIH 1974a; 1974b, p. 46).

Establishment of U.S. OSHA and NIOSH

The first U.S. Occupational Safety and Health Act was passed at the end of 1970, and in 1971 the newly formed Occupational Safety and Health Administration (OSHA) promulgated regulatory requirements for the first time for asbestos that were legally binding in a majority of workplaces in the United States. Authorized by Congress under the OSH Act, OSHA adopted the existing Walsh-Healey standards, which included the 12 f/cc or 2 mppcf eight-hour TWA for asbestos, referred to as a Permissible Exposure Limit (PEL) (OSHA 1971b). The PELs for asbestos over time have been based on both an eight-hour TWA using the same methodology established by the ACGIH TLVs, as well as a 15- or 30-minute short-term TWA for excursions above the eight-hour TWA. In 1972, OSHA reduced the asbestos PEL to 5 f/cc as an eight-hour TWA, and created a 15-minute peak exposure value of 10 f/cc for all asbestos forms. The 1972 standard included a reduction of the eight-hour TWA PEL to 2 f/cc in 1976 (OSHA 1972).

The 1972 OSHA asbestos standard regulated only fibers longer than 5 µm in length (OSHA 1972b). Since 1971, OSHA has employed the filter membrane sampling with phase contrast microscopy (PCM) analysis for the evaluation of airborne asbestos fiber concentrations at work sites in the U.S. for determining airborne concentrations of fibers per cubic centimeters; this method became a requirement under the OSHA asbestos standards in 1972. However, it should be noted that PCM does not discriminate between asbestos fibers and other dimensionally similar fibers. This methodological limitation can lead to overestimations of airborne asbestos concentrations. Transmission electron microscopy or TEM analysis is often used to differentiate between asbestos mineral fiber types (e.g., chrysotile, amosite, and crocidolite) and to distinguish asbestos fibers from non-asbestos fibers. Since the PEL is based on PCM data, TEM analysis is generally used as a secondary method to determine the fraction of asbestos fibers in the total airborne fiber count for comparison with PCM data. This asbestos fiber-specific fraction of the total measured PCM fibers is often called the PCM-equivalent asbestos fiber concentration, or PCME (Sahmel et al. 2014a; Barlow et al. 2017).

In 1973, Dr. Herb Stokinger, the Chairman of the ACGIH TLV committee and Chief of the Toxicology Branch of the U.S. Public Health Service, wrote a letter to the TLV committee stating that recent asbestos epidemiology studies had shown a threshold response for carcinogenicity and asbestos. He calculated in the letter a “margin of safety” for “all types of asbestos related disease, cancers and asbestosis” at the ACGIH TLV of 5 f/cc as averaged over an eight-hour work day (Stokinger 1973). For a 50-year working lifetime at the 5 f/cc eight-hour TWA, the safety factor was estimated at 3.1, equivalent to a cumulative exposure of 250 f/cc-yrs.

Regarding the levels of asbestos exposure necessary to cause disease, published references in the early 1970s clearly demonstrated that this issue had not yet been resolved. According to NIOSH in 1972, “the scant data and the long latent period for the development of bronchogenic cancer and mesothelioma do not permit the establishment of the dose-response relationship [for asbestos] at this time” (NIOSH 1972). Similarly, in 1970, regarding asbestos exposures, Roach stated that, “to derive hygiene standards for an air contaminant which provide a known degree of protection against a health hazard, it is necessary to have a body of data showing the amount of air contaminant to which people are exposed and the corresponding effects or lack of them in the people…Our present information is very imprecise, particularly in terms of the practical consequences of specific hygiene standards” (Roach 1970, p. 14). Nearly all notable exposure studies of occupations in which the employees were potential end users of asbestos-containing products were not published until the 1970s, including for auto mechanics, electricians, dry wall workers, and insulation workers (Hickish et al. 1970; Sawyer 1977; Rohl et al. 1975; Nicholson et al. 1972; Nicholson 1976). It was not until these studies began to be published that the relative exposure potential associated with end users of different asbestos-containing products was understood in terms of airborne fiber concentrations. It was also important that these were among the early exposure studies to report exposures using the PCM analytical method (f/cc) rather than total suspended particulates (mppcf). Without these data, the risk of asbestos exposure could not be quantified in the terms used today by the scientific community (Barlow et al. 2017). For example, in 1977, Rohl et al. stated that with respect to chrysotile-containing brakes specifically, there was a need for “Epidemiological studies of the mortality experience of exposed workers” (Rohl et al. 1977), p. 36).

In 1975, OSHA published a Notice of Proposed Rulemaking to revise the standard for occupational exposure to asbestos (OSHA 1975). In the notice, OSHA stated that “in very recent time,” asbestos in commercial forms had come to be associated with bronchogenic carcinoma (OSHA 1975: p. 47653). Regarding smoking, OSHA reported that a study by Hammond and Selikoff (1973) had confirmed earlier findings indicating that “non-smoking asbestos workers had few lung cancers while those who smoked had much more lung cancer than would have been expected had they not been asbestos workers” (OSHA 1975: p. 47655). It appears likely that smoking among workers complicated the ability of researchers and government regulators to characterize the quantitative association between asbestos exposure and lung cancer.

With respect to asbestos dose-response relationships, a 1980 OSHA/NIOSH report reported that “the exact nature of the dose-response relationships may be subject to considerable debate. This

is … primarily because of problems of exposure estimation. Methods of measuring dust levels have changed over time with respect to sampling instrument (thermal precipitation vs. midget impinger vs. membrane filter), location of sampling (personal vs. area), and dust counting (particles vs. actual fibers) and/or evaluation techniques (whole fields vs. eyepiece graticule)" (NIOSH/OSHA 1980: p. 31).

Mr. LaFrentz's Use of Respiratory Protection at General Dynamics/Lockheed Martin

Mr. LaFrentz testified that during the honeycomb or coupon drilling process, he "had a mask on" (LaFrentz Vol. I: p. 72, l. 7, p. 73). He stated that he was not aware of any policies that required him to use a dust mask while performing the coupon drilling work (LaFrentz Vol. I: p. 74). He did not recall whether he had a dust mask on the very first time he started drilling (LaFrentz Vol. I: p. 74). He stated that he was first prompted to request a dust mask for this work because he was "trying to get away from all the black dust and smell"; he later described a "black fog" (LaFrentz Vol. I: p. 74, l. 25 – p. 75, l. 1; Vol. 2: p. 168). He indicated that he would wear the mask "all the time"(LaFrentz Vol. I: p. 80, l. 17).

Mr. LaFrentz believed that the mask "was a 3M dust protector" and that it "was 8710" (LaFrentz Vol. I: p. 78, l. 4, 7). He reported that he did not have any facial hair during that time or ever (LaFrentz Vol. I: p. 78-79). He believed that he wore the same mask during the three years he was a drill press operator (LaFrentz Vol. I: p. 81). He recalled that "most of the time", he would wear the same mask all day (LaFrentz Vol. I: p. 82, l. 3). He later clarified that it was "probably a week until [he] got the mask" after he started drilling the panels (LaFrentz, Vol. 2: p. 106, l. 8).

Mr. LaFrentz testified that he did not ever see an instruction sheet with the 3M 8710, or any product warnings, literature, brochures, or advertisements (LaFrentz Vol. 2: p. 108).

C_{8hr}: A Review of the Data from Relevant Peer-Reviewed and Government Publications and on Measured Airborne Fiber Concentrations during Work with Adhesive Products

Airborne Fiber Concentration Data Associated with Adhesive Products

Mr. LaFrentz agreed in his testimony that there was a document produced as Exhibit Plaintiff 2 to his deposition that addressed the use of adhesive in the honeycomb aircraft panels he described working with at General Dynamics for approximately two days per month over three years between 1979 and 1981 or 1982 (LaFrentz Vol. 2: p. 162). Specifically, the document

described the material as follows: “FMS 3018 is used in adhesive of P 653 Panels” (LaFrentz Exhibit Plaintiff 2).

The use of chrysotile asbestos in adhesive composites is considered an encapsulated product. Consistent with this characterization of the asbestos exposure potential associated with composite and adhesive materials, at least one peer-reviewed published study has indicated that the use of asbestos-containing coatings, mastics, epoxies, adhesives, and similar products in occupational settings is likely to result in very low concentrations of airborne asbestos, if these concentrations are not below the limit of detection. Such airborne fiber concentrations would have been below both historical and current occupational exposure limits for asbestos, and could be indistinguishable from background concentrations of asbestos in industrial environments.

Paustenbach *et al*. (2004) published a peer-reviewed article titled *Occupational exposure to airborne asbestos from coatings, mastics, and adhesives* in the Journal of Exposure Analysis and Environmental Epidemiology, in which the authors reported on a study conducted to measure the total airborne fiber concentrations during the use of four asbestos-containing products: a coating, two mastics, and an adhesive (Paustenbach et al. 2004). These products contained 1-9 percent asbestos, with the adhesive containing 8-9 percent asbestos. In this study, the personal and area airborne concentrations of asbestos fibers released during five different activities (application, spill cleanup, sanding, removal, and sweep cleaning) were measured during periods of approximately 30 min to 8 hours depending on the activity. Total airborne fiber concentrations were measured using phase contrast microscopy (PCM), and asbestos-specific fiber counts were measured using transmission electron microscopy (TEM) to determine a PCME airborne asbestos concentration. Chrysotile asbestos fibers were detected by TEM in six of 452 samples, indicating that a very low percentage of fibers measured in the air were asbestiform. Task-based airborne chrysotile concentrations ranged from 0.003 to 0.04 fibers per cubic centimeter or ml (f/cc) (PCME by NIOSH 7402). These measurements were well below the current OSHA 8-hr TWA PEL of 0.1 f/cc. In their paper, the authors concluded that these results indicated that there was “virtually no occupational exposure to the asbestos in these products during the application, spill cleanup, cutting and removal, and sweep cleanup” (Paustenbach et al. 2004).

Airborne Fiber Concentration Measurement at General Dynamics in Mr. LaFrentz’s Work Area

The exhibit to Mr. LaFrentz’s testimony addressing the adhesive material tested contained a report with a single airborne fiber sample collected during Mr. LaFrentz’s work at General Dynamics on February 26, 1980. According to the report, a one-minute sample was collected

during "belt sanding P 653 panels" (LaFrentz Plaintiff 2 Exhibit). The airborne fiber concentration over one minute was 28.8 f/cc; the analytical method was not reported, but appeared to be PCM. As noted by Paustenbach et al. (2004), a very small percentage of fibers measured during the manipulation of adhesives may be asbestiform, and therefore PCM concentrations alone may overestimate the asbestos-specific airborne fiber concentration measured using TEM or PCME.

It was noted in the report that during sampling, Mr. LaFrentz "wore a disposable respirator approved for use in asbestos contaminated atmosphere" and described the respirator as a "3M model 8710" (LaFrentz Plaintiff 2 Exhibit).

Summary: Mr. LaFrentz's Cumulative Asbestos Exposure Potential During Drilling Activities Involving Aircraft Test Panels

Any exposure that Mr. LaFrentz may have experienced as a result of working with these encapsulated products would have been well below the cumulative asbestos exposure potential associated with working at the current OSHA PEL for asbestos over 45 years, and also within or below the range of cumulative lifetime ambient or background exposures experienced by anyone in the general U.S. population.

Based on Equation 1 above, the following two parameters are necessary for estimating cumulative exposure potential: duration and frequency of exposure (E_D in years) and the airborne fiber concentration associated with the work performed (C_{8hr} in f/cc).

Summary: Duration and Frequency (E_D) of Exposure Potential to Mr. LaFrentz

Regarding Mr. LaFrentz's work with the honeycomb panels over approximately three years, Mr. LaFrentz described that he would work on a plastic bin of the panels that contained anywhere from 8 to 14 or 20 to 30 panels (LaFrentz Vol. I: p. 65; LaFrentz Vol. 2: p. 118-119). He described that he "might have to do this for two days" and then he "might… not have another bin come out for a month" (LaFrentz Vol. I: p. 65, l. 12-13). This frequency and duration of work is equivalent to 576 hours (8 hours/day x 2 days/month x 36 months). On an occupational year basis, this is equivalent to 0.28 occupational year (576 hours ÷ 2,080 hours/occupational year).

Based on the number of panels he described, and his testimony that he would typically drill either two or four holes per panel, this would approximately equate to an upper bound of approximately 90 holes drilled per plastic bin of panels. Regarding belt sanding specifically, this

might take 10-20 seconds per hole drilled to smooth out any burrs while not also degrading or altering the panel surface, or up to approximately 30 minutes per day (up to 20 sec. per hole drilled x up to 90 holes drilled ÷ 60 sec/min).

Summary: Measured Airborne Fiber Concentrations (C_{8hr}) during Work with Encapsulated Adhesive Products

For adhesives and similar products, Paustenbach et al. (2004) reported that airborne fiber concentration measurements were well below the current OSHA 8-hr TWA PEL of 0.1 f/cc, or between 0.003 f/cc and 0.04 f/cc. Additionally, a very small percentage of airborne fibers measured were asbestiform. The authors concluded that based on the measured results, there would be "virtually no occupational exposure to the asbestos in these products during the application, spill cleanup, cutting and removal, and sweep cleanup" (Paustenbach et al. 2004).

Based on the single sample collected at General Dynamics during Mr. LaFrentz's employment, if he had hypothetically spent as much as 30 minutes per day actively belt sanding panels (as calculated above), and if the airborne fiber concentration reported was representative of asbestos fibers specifically (for which there is no evidence), then the 8-hour TWA airborne fiber concentration during this work would be equivalent to 1.8 f/cc [(28.8 f/cc x 30 minutes) + (a midpoint of 0.02 f/cc during Paustenbach et al. adhesives work x 450 minutes) ÷ 480 min over 8 hours]. According to the sample report in LaFrentz Plaintiff 2 Exhibit, the allowable exposure to asbestos at the time of sample collection was 2 f/cc, indicating that 1.8 f/cc as an 8-hour TWA would have been within the allowable limits at the time of sample collection. Additionally, the use of a respirator would serve to further reduce this exposure potential. At an APF of 10, the user would experience at least a 90% reduction in airborne fiber exposure potential.

Summary: Mr. LaFrentz's Cumulative Exposure Potential (C)

As previously discussed, cumulative lifetime background exposures on a working lifetime basis are equivalent to 45 working years at the current OSHA 8-hour TWA PEL of 0.1 f/cc which equates to a working lifetime of 4.5 fiber/cc-years. Ambient or background cumulative lifetime asbestos exposures to individuals in the U.S. have also been measured and found to be in the range of 0.002 to 0.4 f/cc-year on an environmental year basis (or 0.0084 to 1.68 f/cc-year on an equivalent occupational cumulative exposure basis).

Based on the specific duration and frequency that Mr. LaFrentz described working with the honeycomb aircraft panels (approximately 0.28 occupational year), his work drilling panels at General Dynamics between 1979 and 1981 or 1982 would have resulted in a cumulative lifetime asbestos exposure potential that is well within the occupational-equivalent cumulative working lifetime exposure at the current OSHA PEL of 4.5 f/cc-year, and also well within the background or ambient cumulative asbestos exposures experienced by the general population in the U.S., if not below the limit of detection (see **Eq. 1**). If should be noted that this would be true whether the sampling data from General Dynamics or the sampling data from Paustenbach et al. (2004) is used to calculate cumulative exposure potential. According to the weight of evidence in the peer-reviewed literature, exposures to asbestos to the U.S. population across the wide range of measured and reported background airborne fiber concentrations have not been shown to be associated with a statistically-significant increased risk of asbestos related disease, including mesothelioma.

Additionally, using respiratory protection during this work with an APF of 10 (equivalent to an exposure reduction of 90%) for approximately three years would result in an even lower cumulative exposure, which would be even further within the range of cumulative lifetime background or ambient exposures, if not below the limit of detection.

<u>Mr. LaFrentz's Descriptions of Work Around Insulation</u>

He also recalled that "one year [he] worked as an apprentice steamfitter" and believed that this was the following summer after the construction site job (LaFrentz Vol. I: p. 35, l. 24-25; p. 36, l. 1-2; p. 38). During this employment, he stated that he "helped one guy" and recalled that they were "redoing piping in the basement of an unoccupied hospital" (LaFrentz Vol. I: p. 38, l. 9-10). He indicated that the work he did was consistent with an apprentice, and that he would "put goop on pipes and [screw] them in and all the old pipes out" (LaFrentz Vol. I: p. 38, l. 20-21). He did not recall if they took any insulation off of the piping systems they removed (LaFrentz Vol. I: p. 168). He agreed that "the whole area was always dusty" (LaFrentz Vol. I: p. 170). He did not recall whether he wore any type of dust mast while performing this work (LaFrentz Vol. I: p. 170).

<u>Airborne Fiber Concentration Studies Associated with Insulation Work</u>

Studies have reported that average short-term fiber concentrations associated with insulation work ranged between 1.0 f/cc and 8.4 f/cc in industrial and commercial settings, and 0.2 f/cc and 226 f/cc in maritime settings (Cooper et al. 1968; Harries 1971). Similarly, Balzer et al. (1972)

reported average short-term fiber concentrations during a simulation study in which pipe covering was manipulated via hand sawing, band sawing, and power sawing and indicated that airborne concentrations for personal samples ranged from 1.3 f/cc to 2,629.7 f/cc. In 1986, the U.S. EPA's Airborne Asbestos Health Assessment Update reported that historic asbestos exposures to shipyard and industrial insulation were estimated to be in the range of 3 to 6 f/cc (on a long-term average or full-shift basis) between 1968 and 1971 (Nicholson 1972; USEPA 1986a). Acknowledging that certain asbestos-containing insulation products may have contained nearly double the asbestos content in the years prior to 1968, the study suggested that average exposures of insulation workers in the U.S. could have ranged from 10 to 15 f/cc for insulators in commercial and industrial construction and 15 to 20 f/cc for insulators in marine construction (USEPA 1986a).

It is well documented that from the 1930s until the early 1960s, amosite was the predominant fiber type used in many military and industrial insulation applications in both the U.S. and Europe (Balzer et al. 1968; Cooper et al. 1968; Mangold 2003; Murphy et al. 1971; Rushworth 2005; Harries 1968). Beginning in the 1930s, the U.S. Navy started using amosite asbestos insulation, and the use of this insulation on pipes and equipment was widespread due to its low thermal conductivity, strength, light weight, and high temperature limit (Fleischer et al. 1946). According to U.S. Navy specifications, the composition of asbestos-containing insulation was approximately 57-95% amosite and 6-43% chrysotile (Rushworth 2005). Similarly, Balzer and Cooper reported the asbestos content of insulation generally to be variable, and stated that insulation could contain chrysotile, amosite, other materials, or a combination of fiber types (Balzer et al. 1968). Entities such as Johns Manville and Owens Corning manufactured many insulating products, including products such as Kaylo insulation and Johns Manville insulation, that historically contained amphibole asbestos, for a wide variety of uses (Johns-Manville 1973, 1950-1965; Owens Corning 2000; Helser 1984; Johns-Manville 1963).

In the mid-1960s, researchers first demonstrated through epidemiological studies that tradesmen who routinely handled or worked in the vicinity of others using amosite-containing insulation were at an increased risk of developing asbestos-related diseases (Selikoff et al. 1965b; Selikoff 1965). This was likely due, in part, to the substantial concentrations of airborne asbestos fibers generated while thermal insulation was sprayed, installed, repaired, or removed from various structures, equipment, and associated piping.

VI. CLOSING COMMENTS

I submit these comments and am prepared to support them in both deposition and/or courtroom testimony. I may supplement this report if additional information becomes available or I am asked to address other issues.

Respectfully,

_________________________________ August 14, 2020

Jennifer Sahmel, MPH, CIH, CSP, FAIHA Date

Managing Principal Scientist

VII. REFERENCES

Abelmann, A., M. E. Glynn, J. S. Pierce, P. K. Scott, S. Serrano, and D. J. Paustenbach. 2015. Historical ambient airborne asbestos concentrations in the United States - an analysis of published and unpublished literature (1960s-2000s). *Inhalation Toxicology* 27 (14):754-766.

ACGIH. 1955. Report of the Committee on Thresholds Limits. In *Transactions of the Seventeenth Annual Meeting of the American Conference of Governmental Industrial Hygienists. April 23-26, 1955*. Buffalo, NY: American Conference of Governmental Industrial Hygienists. p. 44-46.

ACGIH. 1968. Transactions of the Thirtieth Annual Meeting of the American Conference of Governmental Industrial Hygienists: St. Louis, Missouri, May 12-14, 1968. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

ACGIH. 1974a. TLVs Threshold Limit Values for Chemical Substances in Workroom Air Adopted by ACGIH for 1974. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

ACGIH. 1974b. TLVs threshold limit values for chemical substances in workroom air adopted by the American Conference of Governmental Industrial Hygienists for 1973. *Journal of Occupational Medicine* 16 (1):39-49.

ACGIH. 1978. TLVs Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1978. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

ACGIH. 1980. Documentation of the Threshold Limit Values. Fourth Edition. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

ACGIH. 1998. Supplements to the Sixth Edition. Documentation of Threshold Limit Values and Biological Exposure Indices. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

ACGIH. 2001. Chronology of the ACGIH TLVs for Asbestos. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

American Standards Association. 1959. Z2.1 American Standard Safety Code for Head, Eye, and Respiratory Protection. Approved November 27, 1959.

ANSI. 1969. ANSI Z88.2-1969. American National Standard: Practices for Respiratory Protection. New York: American National Standards Institute.

ANSI. 1980. ANSI Z88.2-1980. American National Standard Practices for Respiratory Protection. Adopted May 22, 1980.

ANSI. 1992. ANSI Z88.2-1992. American National Standard for Respiratory Protection. Approved August 6, 1992.

Antman, K. H., P. B. Schiff, and H. I. Pass. 1997. Benign and malignant mesothelioma. In *Cancer: Principles & Practice of Oncology*, edited by V. T. DeVita, S. S. Hellman and S. A. Rosenberg. Philadelphia: Lippincott-Raven Publishers. p. 1853-1878.

Armstrong, T. W., F. W. Boelter, and J. O. Rasmuson. 2009. Exposure reconstruction. In *Mathematical Models for Estimating Occupational Exposure to Chemicals, 2nd Edition*, edited by C. Keil, C. Simmons and T. R. Anthony. Fairfax, VA: American Industrial Hygiene Association. p. 157-186.

Asbestos Worker Journal. 1969-1972. Insulation Hygiene Progress Reports, Vols 1-4.

ASSE. 2017. ANSI/ASSE Z88.2 - 2015 Practices for Respiratory Protection. In Industrial Safety Hygiene News. BNP Media. .

ASTM. 1952a. ASTM Designation: D 299-52T, Tentative Specifications and Methods of Test for Asbestos Yarns. Philadelphia, PA: American Society for Testing Materials.

ASTM. 1952b. ASTM Designation: D 375-52, Standard Specifications and Methods of Test for Asbestos Roving for Electrical Purposes. Philadelphia, PA: American Society for Testing Materials.

ASTM. 1952c. ASTM Designation: D 577-52, Standard Methods of Testing Woven Asbestos Cloth. Philadelphia, PA: American Society for Testing Materials.

ASTM. 1952d. ASTM Designation: D 628-52, Standard Methods of Testing Asbestos Tubular Sleeving. Philadelphia, PA: American Society for Testing Materials.

ASTM. 1956a. ASTM Designation: C 298-56, Standard Specifications for Cellular Asbestos Paper Thermal Insulation for Pipes. Philadelphia, PA: American Society for Testing Materials.

ASTM. 1956b. ASTM Designation: C 299-56, Standard Specifications for Laminated Asbestos Thermal Insulation for Pipes. Philadelphia, PA: American Society for Testing Materials.

ASTM. 1956c. ASTM Designation: D 250-56, Standard Specification for Asphalt-Saturated Asbestos Felts for Use in Waterproofing and in Constructing Built-Up Roofs. Philadelphia, PA: American Society for Testing Materials.

ATSDR. 2001. Toxicological Profile for Asbestos. September 2001. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry.

Avens, H. J., J. R. Maskrey, A. L. Insley, K. M. Unice, R. C. D. Reid, and J. Sahmel. 2018. Characterization of airborne BTEX exposures during use of lawnmowers and trimmers. *Archives of Environmental and Occupational Health* ePub: DOI: 10.1080/19338244.2018.1426552.

Ayer, H. E., J. R. Lynch, and J. H. Fanney. 1965. A comparison of impinger and membrane filter techniques for evaluating air samples in asbestos plants. *Annals of the New York Academy of Sciences* 132 (1):274-87.

Baetjer, A. M. 1984. The early days of industrial hygiene- Their contribution to current problems. In *Threshold Limit Values: Discussion and Thirty-Five Year Index with Recommendations. Annals of the American Conference of Industrial Hygienists: Volume 9*, edited by M. E. LaNier. Cincinnati, OH: American Conference of Governmental Industrial Hygienists. p. 15-20.

Balzer, J., D. P. Fowler, and W. Clark Cooper. 1972. Dust-producing potential of construction materials. In *Safety and Health in Shipbuilding and Ship Repairing. Proceedings of a Symposium Organized by the Government of Finland, the Institute of Occupational Health, Helsinki, the Finnish Accident Prevention Association and Organisations of Employers and Workers in the Finnish Shipbuilding Industry, in Collaboration with the International Labour Office, Held in Helsinki, Finland, 30 August- 2 September 1971*, edited by International Labour Office. Geneva: International Labour Office. p. 107-122.

Balzer, J. L., and W. C. Cooper. 1968. The work environment of insulating workers. *American Industrial Hygiene Association Journal* 29 (3):222-7.

Barlow, C. A., J. Sahmel, D. J. Paustenbach, and J. L. Henshaw. 2017. History of knowledge and evolution of occupational health and regulatory aspects of asbestos exposure science: 1900-1975. *Critical Reviews in Toxicology* 47 (4):286-316.

Baxter, D., R. Ziskind, and R. Shokes. 1983a. Final Report: Ambient Asbestos Concentrations in California, Field Number and Mass Concentration Summaries, Volume II. December 1, 1983. Sacramento, CA: California Air Resources Board.

Baxter, D., R. Ziskind, and R. Shokes. 1983b. Final Report: Ambient Asbestos Concentrations in California, Volume I. Sacramento, CA: California Air Resources Board.

Bayer, S. G., R. D. Zumwalde, and T. A. Brown. 1969. Equipment and Procedure for Mounting Millipore Filters and Counting Asbestos Fibers by Phase Contrast Microscopy. Cincinnati,OH: Bureau of Occupational Health, U.S. Dept. of Health, Education and Welfare.

Boeniger, M., J. Sahmel, J. Walton, and R. Roy. 2015. Appendix II: Dermal exposure monitoring and estimation of dermal exposures. In *A Strategy for Assessing and Managing Occupational Exposures. 4th Edition*, edited by S. D. Jahn, W. H. Bullock and J. S. Ignacio. Fairfax, VA: AIHA. p. 381-399.

Braun, D. C., and T. D. Truan. 1958. An epidemiological study of lung cancer in asbestos miners. *AMA Arch Ind Health* 17 (6):634-53.

Burns, A. M., C. A. Barlow, A. M. Banducci, K. M. Unice, and J. Sahmel. 2019. Potential Airborne Asbestos Exposure and Risk Associated with the Historical Use of Cosmetic Talcum Powder Products. *Risk Anal* doi: 10.1111/risa.13312. [Epub ahead of print].

Cal/EPA Air Resources Board. 2015. Asbestos Air Monitoring- Oakridge High School, El Dorado Hills. Accessed December 7, 2016: https://www.arb.ca.gov/toxics/asbestos/orhs.htm.

Camus, M., J. Siemiatycki, B. W. Case, M. Desy, L. Richardson, and S. Campbell. 2002. Risk of mesothelioma among women living near chrysotile mines versus USEPA asbestos risk model: Preliminary findings. *Ann Occup Hyg* 46 (Suppl 1):95-98.

Committee on Carcinogenicity. 2013. Statement of the Relative Vulnerability of Children to Asbestos Compared to Adults. CC/13/S1. United Kingdom: Committee on Carcinogenicity of Chemicals in Food, Consumer Products and the Environment, Public Health England. 2013.

Cooper, W. C., and J. L. Balzer. 1968. Evaluation and control of asbestos exposure in the insulating trade. In *Second International Conference on the Biological Effects of Asbestos, April 21-24, 1968*. Dresden, Germany. p. 151-160.

Crump, K. S., and D. B. Farrar. 1989. Statistical analysis of data on airborne asbestos levels collected in an EPA survey of public buildings. *Regul Toxicol Pharmacol* 10 (1):51-62.

Department of Labor. 1951. For Contractors Performing Federal Supply Contracts Under the Walsh-Healey Public Contracts Act. Contracts Division. Washington, D.C.: U.S. Department of Labor, Wage and Hour Public Contracts Division.

Department of Labor. 1952. Safety and Health Standards for Contractors Performing Federal Supply Contracts Under the Walsh-Healey Public Contracts Act. Washington, D.C.: U.S. Department of Labor, Wage and Hour Public Contracts Division.

Department of Labor. 1960. Part 50-204: Safety and Health Standards for Federal Supply Contracts. Fed. Reg. 25(251):13809-13825. December 28, 1960.

Department of Labor. 1966. General Safety and Health Standards for Federal Supply Contracts Under the Walsh-Healey Public Contracts Act. Washington, D.C.: U.S. Department of Labor, Bureau of Labor Standards.

Doll, R. 1955. Mortality from lung cancer in asbestos workers. *British Journal of Industrial Medicine* 12 (2):81-6.

Donovan, E. P., B. L. Donovan, J. Sahmel, P. K. Scott, and D. J. Paustenbach. 2011. Evaluation of bystander exposures to asbestos in occupational settings: A review of the literature and application of a simple eddy diffusion model. *Critical Reviews in Toxicology* 41 (1):50-72.

Dreessen, W. C., J. M. Dallavalle, T. I. Edwards, J. W. Miller, and R. R. Sayers. 1938. A Study of Asbestosis in the Asbestos Textile Industry, Public Health Bulletin No. 241. August 1938. Washington, D.C.: U.S. Treasury Department, Public Health Service, National Institute of Health, Division of Industrial Hygiene.

Eckardt, R. E., and P. Drinker. 1954. Experimental lung cancer. *AMA Arch Ind Hyg Occup Med* 9 (6):449-50.

Enterline, P. E. 1991. Changing attitudes and opinions regarding asbestos and cancer 1934-1965. *Am J Ind Med* 20 (5):685-700.

Finkelstein, M. M. 1983. Mortality among long-term employees of an Ontario asbestos-cement factory. *Br J Ind Med* 40 (2):138-44.

Fleischer, W. E., F. J. J. Viles, R. L. Gade, and P. Drinker. 1946. A health survey of pipe covering operations in constructing naval vessels. *Journal of Industrial Hygiene and Toxicology* 28 (1):9-16.

Frederick, W. G. 1984. The birth of the ACGIH Threshold Limit Values committee and its influence on the development of industrial hygiene. In *Threshold Limit Values: Discussion and Thirty-Five Year Index with Recommendations. Annals of the American Conference of Industrial Hygienists: Volume 9*, edited by M. E. LaNier. Cincinnati, OH: American Conference of Governmental Industrial Hygienists. p. 11-13.

Gilson, J. C. 1965. Problems and perspectives: The changing hazards of exposure to asbestos. *Ann NY Acad Sci* 132 (1):696-705.

Glynn, M. E., K. A. Keeton, S. H. Gaffney, and J. Sahmel. 2018. Ambient Asbestos Fiber Concentrations and Long-Term Trends in Pleural Mesothelioma Incidence between Urban and Rural Areas in the United States (1973-2012). *Risk Anal* 38 (3):454-471.

Hannon, J. W. G., P. Cartier, R. K. Childerhose, D. T. Dubow, G. W. H. Schepers, R. Smart, H., and R. E. Whitehead. 1964. Asbestosis; Report of the Section on Nature and Prevalence, Committee on Occupational Diseases of the Chest, American College of Chest Physicians. *Diseases of the Chest* 45:107-11.

Harries, P. G. 1968. Asbestos hazards in naval dockyards. *Ann Occup Hyg* 11 (2):135-45.

Harries, P. G. 1971. Asbestos dust concentrations in ship repairing: a practical approach to improving asbestos hygiene in naval dockyards. *Annals of Occupational Hygiene* 14 (3):241-54.

Heffelfinger, R. E., C. W. Melton, and D. L. Kiefer. 1972. Development of a Rapid Survey Method of Sampling and Analysis for Asbestos in Ambient Air: Final Report Covering the Period July 1969 Through July 1971. February 29, 1972. Research Triangle Park, N.C.: U.S. Environment Protection Agency, Division of Atmospheric Surveillance.

HEI-AR. 1991. Asbestos in Public and Commercial Buildings: A Literature Review and Synthesis of Current Knowledge. Cambridge, MA: Health Effects Institute-Asbestos Research.

Helser, J. 1984. Testimony in Kitsap County asbestos cases of Schroeter, Goldmark &Bender. Case No. 80-2-00689-6 in The Superior Court of the state of Washington in and for the County of Kitsap. May 21, 1984.

Henshaw, J. L., S. H. Gaffney, A. K. Madl, and D. J. Paustenbach. 2007. The employer's responsibility to maintain a safe and healthful work environment: An historical review of societal expectations and industrial practices. *Employ Respons Rights J* 19:173-192.

Hickish, D. E., and K. L. Knight. 1970. Exposure to asbestos during brake maintenance. *Ann Occup Hyg* 13 (1):17-21.

Home Office. 1935. Memorandum on the Industrial Diseases of Silicosis and Asbestosis. February 1935. London: His Majesty's Stationery Office.

Hueper, W. C. 1955. Silicosis, asbestosis, and cancer of the lung. *Am J Clin Pathol* 25 (12):1388-90.

Hueper, W. C. 1957. Role of occupational and environmental air pollutants in production of respiratory cancers. *AMA Arch Pathol* 63 (5):427-50.

Ignacio, J., and W. Bullock. 2006. A Strategy for Assessing and Managing Occupational Exposure. Third edition. Fairfax, VA: American Industrial Hygiene Association Press.

Isselbacher, K. J., H. Klaus, and H. L. Hardy. 1953. Asbestosis and bronchogenic carcinoma; Report of one autopsied case and review of the available literature. *American Journal of Medicine* 15 (5):721-32.

Jahn, S. D., W. H. Bullock, and J. S. Ignacio. 2015. A Strategy for Assessing and Managing Occupational Exposures. 4th Edition. ISBN: 1935082469. Fairfax, VA: AIHA.

Jeffress, C. N. 1999. Letter to W.L. Dyson, Workplace Hygiene, Re: Clarification of OSHA's Risk Assessment and Approach for Setting the Asbestos PEL.[1910.1001(c); 1926.1101(c)]. Accessed July 23, 1999: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=22770.

Johns-Manville. 1950-1965. Johns-Manville Manufacturing Specification: Thermobestos Blocks and Pipe Covering. Various Plants & Divisions.

Johns-Manville. 1963. Insulation Catalog.

Johns-Manville. 1973. Memo from W.C. Streib to G.W. Wright RE: Asbestos In J-M Insulations. Dated May 24, 1973.

Keil, C. B., C. E. Simmons, and T. R. Anthony. 2009. Mathematical Models for Estimating Occupational Exposure. Second edition. Fairfax, VA: American Industrial Hygiene Association Press.

Knowlson, J. S. 1942. Part 1064- Asbestos: Conservation Order M-79 Curtailing the Use of Certain Types of Asbestos, January 21, 1942. *Federal Register* 7 (1-22):436.

Kopelovich, L. M., K. A. Thuett, P. S. Chapman, and D. J. Paustenbach. 2014. History and evolution of warning labels for automotive friction products. *Regul Toxicol Pharmacol* 68 (3):402-11.

LaNier, M. E. 1984. Report of the sub-committee on threshold limits. In *Threshold Limit Values: Discussion and Thirty-Five Year Index with Recommendations. Annals of the American Conference of Governmental Industrial Hygienists: Volume 9*, edited by M. E. LaNier. Cincinnati, OH: American Conference of Governmental Industrial Hygienists. p. 343-345.

Lanza, A. J. 1938. History of silicosis and asbestosis. In *Silicosis and Asbestosis*. London: Oxford University Press. p. 3-30.

Lee, R. J., and D. R. Van Orden. 2008. Airborne asbestos in buildings. *Regulatory Toxicology and Pharmacology* 50 (2):218-25.

Lee, R. J., D. R. Van Orden, M. Corn, and K. S. Crump. 1992. Exposure to airborne asbestos in buildings. *Regul Toxicol Pharmacol* 16 (1):93-107.

Lynch, J. R., and H. E. Ayer. 1968. Measurement of asbestos exposure. *Journal of Occupational Medicine* 10 (1):21-4.

MacLaury. n.d. Government Regulation of Workers' Safety and Health, 1877-1917. U.S. Department of Labor. https://www.dol.gov/general/aboutdol/history/mono-regsafeintrotoc. Accessed January 27, 2020. .

Mangold, C. A. 2003. Amosite Insulation. Use of Amosite Insulations and Products Aboard U.S. Naval and Contract Ships in the 1940s, 1950s, 1960s, and 1970s. Bellevue, WA: Environmental Control Sciences Inc.

Marr, W. T. 1964. Asbestos Exposure During Naval Vessel Overhaul. *American Industrial Hygiene Association Journal* 25:264-8.

McDonald, J. C. 1985. Health implications of environmental exposure to asbestos. *Environmental Health Perspectives* 62:319-28.

McDonald, J. C., and A. McDonald. 1994. Mesothelioma: Is there a background? In *The Mesothelial Cell and Mesothelioma*, edited by M. Jaurand and J. Bignon. New York: Marcel Decker. p. 37-45.

Merewether, E. R. A. 1930. The occurrence of pulmonary fibrosis and other pulmonary affections in asbestos workers. *Journal of Industrial Hygiene* 12:198-222; 239-257.

Merewether, E. R. A. 1933. A Memorandum on Asbestosis. *Tubercle* 15:69-81, 109-118, 152-159.

Merewether, E. R. A. 1934. A memorandum on asbestosis. *Tubercle* 15 (4):152-159.

Merewether, E. R. A. 1949. Annual Report of the Chief Inspector of Factories for the Year 1947: Presented by the Minister of Labour and National Service to Parliament of Command of His Majesty. January 1949. London: His Majesty's Stationery Office.

Merewether, E. R. A., and C. W. Price. 1930. Report on Effects of Asbestos Dust on the Lungs and Dust Suppression in the Asbestos Industry. Part I and II. London: His Majesty's Stationery Office.

Moolgavkar, S. H., R. Meza, and J. Turim. 2009. Pleural and peritoneal mesotheliomas in SEER: Age effects and temporal trends, 1973-2005. *Cancer Causes and Control* 20 (6):935-44.

Moore, A. J., R. J. Parker, and J. Wiggins. 2008. Malignant mesothelioma. *Orphanet Journal of Rare Diseases* 3:34.

Murphy, R. L., Jr., B. G. Ferris, Jr., W. A. Burgess, J. Worcester, and E. A. Gaensler. 1971. Effects of low concentrations of asbestos. Clinical, environmental, radiologic and epidemiologic observations in shipyard pipe coverers and controls. *New England Journal of Medicine* 285 (23):1271-8.

National Safety Council. 1963. Dusts, Fumes, and Mists in Industry. *National Safety News* 87 (6):89-105.

NBS (National Bureau of Standards). 1938. American Standard Safety Code for the Protection of Heads, Eyes, and Respiratory Organs, (Supersedes H2), Issued November 1, 1938. NBS handbook: 24. Washington, D.C.: U.S. GPO.

Nicholson, W. J. 1972. The Characterization of Asbestos Dust Levels in Insulation Work. New York: Environmental Sciences Laboratory.

Nicholson, W. J. 1976. Case study 1: Asbestos--the TLV approach. *Annals of the New York Academy of Sciences* 271:152-69.

Nicholson, W. J. 1987. Airborne Levels of Mineral Fibres in the Non-Occupational Environment.

Nicholson, W. J., D. A. Holaday, and H. Heimann. 1972. Direct and indirect occupational exposure to insulation dusts in United States shipyards. In *Proceedings of an International Symposium on Safety and Health in Ship Building and Ship Repairing; Helsinki, Finland. Occupational Safety and Health Series: 27*. Geneva, Switzerland: International Labour Organization. p. 37-47.

NIOSH. 1972. Criteria for a Recommended Standard: Occupational Exposure to Asbestos. HSM 72-10267. Washington, D.C.: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health.

NIOSH. 2017. Current Intelligence Bulletin: 68. NIOSH Chemical Carcinogen Policy. DHHS (NIOSH) Publication No. 2017–100. December 2016, edited by C. Whittaker, F. Rice, L. McKernan, D. Dankovic, T. Lentz, K. MacMahon, E. Kuempel, R. Zumwalde and P. Schulte. Atlanta, GA: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

NIOSH/OSHA. 1980. Workplace exposure to asbestos: review and recommendations. NIOSH-OSHA Asbestos Work Group. DHHS (NIOSH) Publication No. 81-103. November 1980. Rockville, MD: U.S. Dept. of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health.

Nolan, R. P., and A. M. Langer. 2001. Concentration and type of asbestos fibers in air inside buildings. In *The Health Effects of Chrysotile Asbestos: Contribution of Science to Risk-Management Decisions. The Canadian Mineralogist Special Publication: 5*, edited by R. P. Nolan, A. M. Langer, M. Ross, F. J. Wicks and R. F. Martin. Ottawa, Canada: Mineralogical Association of Canada. p. 39-51.

Nordmann, M. 1938. An occupational cancer of asbestos workers. *Zeitschrift fur Krebsforschung* 47:228-302.

OSHA. 1971a. 29 CFR Part 1910: Occupational Safety and Health Standards, Emergency Standard for Exposure to Asbestos Dust. Fed. Reg. 36(234): 23207-23208. December 7, 1971.

OSHA. 1971b. 29 CFR Part 1910: Occupational Safety and Health Standards, National Consensus Standards and Established Federal Standards (Introduction, Subparts A and B, and portion of Subpart G). Fed. Reg. 36(105): 10466-10469, 10503-10506. May 29, 1971.

OSHA. 1972a. 29 CFR 1910 - Occupational Safety and Health Standards. Subpart I - Personal Protective Equipment, and Subpart G - Occupational Health and Environmental Control. Includes Part 1910. 132 - General Requirements for Personal Protective Equipment, and Part 1910.134 - Respiratory Protection. Revised as of January 1, 1972. Pages 118-125, and Pages 358-363, and Pages 190-221.

OSHA. 1972b. 29 CFR Part 1910: Occupational Safety and Health Standards, Standard for Exposure to Asbestos Dust. Fed. Reg. 37(110): 11318-11322. June 7, 1972.

OSHA. 1975. 29 CFR Part 1910: Occupational Exposure to Asbestos, Notice of Proposed Rulemaking. Fed. Reg. 40(197): 47652-47665. October 9, 1975.

OSHA. 1982. 29 CFR Parts 1910, 1915-1918, and 1926. Respiratory Protection. Advanced Notice of Proposed Rulemaking. Fed. Reg. Vol. 47, No. 94. Friday May 14, 1982. p. 20803 - 20809.

OSHA. 1983a. 29 CFR Part 1910: Hazard Communication. Final Rule. Fed. Reg. 48(228): 53280-53348. November 25, 1983.

OSHA. 1983b. Quantitative Risk Assessment for Asbestos Related Cancers. Revised, October 1983. Washington, D.C.: U.S. Department of Labor, Occupational Safety and Health Administration.

OSHA. 1986. 29 CFR Parts 1910 and 1926: Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite; Final Rules. Fed. Reg. 51(119): 22612-22790. June 20, 1986.

OSHA. 1988. 29 CFR Parts 1910 and 1926: Occupational exposure to asbestos, tremolite, anthophyllite, and actinolite; Final rules; Amendment. Fed. Reg. 53: 35610-35629. September 14, 1988.

OSHA. 1990. 29 CFR Parts 1910 and 1926: Occupational exposure to asbestos, tremolite, anthophyllite and actinolite; Proposed rule. Fed. Reg. 55(140):29712-29753. July 20, 1990.

OSHA. 1994. 29 CFR Parts 1910, 1915, and 1926. RIN: 1218-AB25. Occupational Exposure to Asbestos; Final Rule. Fed. Reg. 59(153):40964-41162. August 10, 1994.

OSHA. 1997. Method ID-160: Asbestos in Air. Washington, D.C.: U.S. Department of Labor, Occupational Safety and Health Administration.

OSHA. 1998a. 29 CFR Parts 1910 and 1926. Respiratory Protection; Final Rule. January 8, 1998. Fed. Reg. 63(5): 1152-1300.

OSHA. 1998b. Inspection Procedures for the Hazard Communication Program. OSHA CPL 02-02.038. Washington, D.C.: U.S. Department of Labor, Occupational Safety and Health Administration.

OSHA. 2002. Title 41--Labor, Chapter L, Part 50-201--General Regulations, The Walsh-Healey Public Contracts Act. July 1, 2002. Washington, D.C.: U.S. Department of Labor, Occupational Safety and Health Administration.

OSHA. 2006. 29 CFR Parts 1910, 1915, and 1926. Assigned Protection Factors; Final Rule. August 24, 2006. Fed. Reg. 71(164): 50122-50192.

OSHA (Occupational Safety and Health Administration). 1991. Standard Interpretation. August 15, 1991. Decision or Policy Statement Regarding the Obligations and Responsibilities of the Employee Leasing Industry with Respect to Compliance with the Occupational Safety and Health Act.[1910.1200; 1910.1030; 1910.178(l)]. Accessed April 10, 2014: https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=20362.

Owens Corning. 2000. Owens Corning Financial Reorganization: Asbestos Chronology. Accessed March 15, 2017: http://www2.owenscorning.com/finre/asbestos.html.

Paustenbach, D. J., J. S. Knutsen, D. M. Hollins, J. E. Sahmel, and A. K. Madl. 2010. Comparison of modeled and measured concentrations of airborne benzene from the use of petroleum-based solvents spiked with low levels of benzene. *Chem Biol Interact* 184 (1-2):296-8.

Paustenbach, D. J., A. Sage, M. Bono, and F. Mowat. 2004. Occupational exposure to airborne asbestos from coatings, mastics, and adhesives. *Journal of Exposure Analysis and Environmental Epidemiology* 14 (3):234-44.

Peters, G., and J. T. Woolley. n.d.-a. Gerald R. Ford: Executive Order 11807 - Occupational Safety and Health Programs for Federal Employees. The American Presidency Project. University of California, Santa Barbara. https://www.presidency.ucsb.edu/documents/executive-order-11807-occupational-safety-and-health-programs-for-federal-employees. Accessed January 27, 2020.

Peters, G., and J. T. Woolley. n.d.-b. Richard Nixon Executive Order 11612 - Occupational Safety and Health Programs for Federal Employees. The American Presidency Project. University of California, Santa Barbara. https://www.presidency.ucsb.edu/documents/executive-order-11612-occupational-safety-and-health-programs-for-federal-employees. Access January 27, 2020.

Peto, J. 1980. Lung cancer mortality in relation to measured dust levels in an asbestos textile factory. *IARC Sci Publ* (30):829-36.

Price, B., and A. Ware. 2004. Mesothelioma trends in the United States: An update based on Surveillance, Epidemiology, and End Results Program data for 1973 through 2003. *American Journal of Epidemiology* 159 (2):107-12.

Price, B., and A. Ware. 2005. Mesothelioma: risk apportionment among asbestos exposure sources. *Risk Anal* 25 (4):937-43.

Reid, A., J. Heyworth, N. H. de Klerk, and B. Musk. 2008. Cancer incidence among women and girls environmentally and occupationally exposed to blue asbestos at Wittenoom, Western Australia. *Int J Cancer* 122 (10):2337-44.

Roach, S. A. 1970. Hygiene standards for asbestos. *Ann Occup Hyg* 13 (1):7-15.

Robin, E. D., and R. P. O'Neill. 1963. The pneumoconioses. Diagnosis, evaluation, and management. *Archives of Environmental Health* 7:130-71.

Rohl, A. N., A. M. Langer, R. Klimentidis, M. S. Wolff, and I. J. Selikoff. 1977. Asbestos content of dust encountered in brake maintenance and repair. *Proc R Soc Med* 70 (1):32-7.

Rohl, A. N., A. M. Langer, I. J. Selikoff, and W. J. Nicholson. 1975. Exposure to asbestos in the use of consumer spackling, patching, and taping compounds. *Science* 189 (4202):551-3.

Rothstein, M. A. 1998. Occupational Safety and Health Law. Fourth Edition. West's Employment Law Series. 4th edition. St. Paul, MN: West Group.

Rushworth, D. H. 2005. The Navy and asbestos thermal insulation. *Naval Engineers Journal* Spring 2005:35-48.

Sahmel, J., H. J. Avens, P. K. Scott, K. Unice, A. Burns, C. A. Barlow, A. K. Madl, J. Henshaw, and D. J. Paustenbach. 2015a. Measured removal rates of chrysotile asbestos fibers from air

and comparison with theoretical estimates based on gravitational settling and dilution ventilation. *Inhalation Toxicology* 27 (14):787-801.

Sahmel, J., C. A. Barlow, S. Gaffney, H. J. Avens, A. K. Madl, J. Henshaw, K. Unice, D. Galbraith, G. DeRose, R. J. Lee, D. Van Orden, M. Sanchez, M. Zock, and D. J. Paustenbach. 2016. Airborne asbestos take-home exposures during handling of chrysotile-contaminated clothing following simulated full shift workplace exposures. *Journal of Exposure Science and Environmental Epidemiology* 26:48-62.

Sahmel, J., C. A. Barlow, B. Simmons, S. H. Gaffney, H. J. Avens, A. K. Madl, J. Henshaw, R. J. Lee, D. Van Orden, M. Sanchez, M. Zock, and D. J. Paustenbach. 2014a. Evaluation of take-home exposure and risk associated with the handling of clothing contaminated with chrysotile asbestos. *Risk Analysis* 34 (8):1448-68.

Sahmel, J., and M. Boeniger. 2006a. Dermal exposure assessments. In *A Strategy for Assessing and Managing Occupational Exposure, Third Edition*, edited by J. Ignacio and W. Bullock. Fairfax, VA: American Industrial Hygiene Association Press. p. 137-161.

Sahmel, J., and M. Boeniger. 2015b. Dermal exposure assessments. In *A Strategy for Assessing and Managing Occupational Exposures. 4th Edition*, edited by S. D. Jahn, W. H. Bullock and J. S. Ignacio. Fairfax, VA: AIHA. p. 171-195.

Sahmel, J., M. Boeniger, and C. Fehrenbacher. 2006b. Appendix II: Dermal exposure assessment methods. In *A Strategy for Assessing and Managing Occupational Exposure, Third Edition*, edited by J. Ignacio and W. Bullock. Fairfax, VA: American Industrial Hygiene Association Press. p. 305-333.

Sahmel, J., M. Boeniger, J. Knutsen, W. ten Berge, and M. C. Fehrenbacher. 2009a. Dermal Exposure Modeling. In *Mathematical Models for Estimating Occupational Exposure, 2nd Edition*, edited by C. B. Keil, C. E. Simmons and T. R. Anthony. Fairfax, VA: American Industrial Hygiene Association Press. p. 105-132.

Sahmel, J., K. Devlin, D. Paustenbach, D. Hollins, and S. Gaffney. 2010. The role of exposure reconstruction in occupational human health risk assessment: Current methods and a recommended framework. *Critical Reviews in Toxicology* 40 (9):799-843.

Sahmel, J., S. Gaffney, J. Knutsen, B. Epstien, and D. Paustenbach. 2014b. Determinants of carbon monoxide exposure inside a motor home during on-board generator use. *International Journal of Vehicle Safety* 7 (3-4):409-424.

Sahmel, J., E. I. Hsu, H. J. Avens, E. M. Beckett, and K. D. Devlin. 2015c. Estimation of hand-to-mouth transfer efficiency of lead. *Annals of Occupational Hygiene* 59 (2):210-20.

Sahmel, J., K. Unice, P. Scott, D. Cowan, and D. Paustenbach. 2009b. The use of multizone models to estimate an airborne chemical contaminant generation and decay profile: Occupational exposures of hairdressers to vinyl chloride in hairspray during the 1960s and 1970s. *Risk Analysis* 29 (12):1699-725.

Sander, O. A. 1958. The pulmonary dust diseases. In *Industrial Hygiene and Toxicology, Second Revised Edition, Volume I, General Principles*, edited by F. A. Patty. New York: Interscience Publishers Inc., John Wiley & Sons. p. 357-411.

Sawyer, R. N. 1977. Asbestos exposure in a Yale building. Analysis and resolution. *Environ Res* 13 (1):146-69.

Seidman, H., I. J. Selikoff, and E. C. Hammond. 1979. Short-term asbestos work exposure and long-term observation. *Ann N Y Acad Sci* 330:61-89.

Selikoff, I. J. 1965. The occurrence of pleural calcification among asbestos insulation workers. *Ann NY Acad Sci* 132 (1):351-67.

Selikoff, I. J. 1969. Industrial Hygiene Progress Reports. Spring 1969. Volume 1, Issue 1.

Selikoff, I. J. 1970. Partnership for prevention--the insulation industry hygiene research program. *IMS, Industrial Medicine and Surgery* 39 (4):162-6.

Selikoff, I. J., J. Churg, and E. C. Hammond. 1964. Asbestos exposure and neoplasia. *JAMA* 188:22-6.

Selikoff, I. J., J. Churg, and E. C. Hammond. 1965a. The occurrence of asbestosis among insulation workers in the United States. *Annals of the New York Academy of Sciences* 132 (1):139-55.

Selikoff, I. J., J. Churg, and E. C. Hammond. 1965b. Relation between exposure to asbestos and mesothelioma. *N Engl J Med* 272:560-5.

Selikoff, I. J., E. C. Hammond, and H. Seidman. 1979. Mortality experience of insulation workers in the United States and Canada, 1943--1976. *Ann N Y Acad Sci* 330:91-116.

Selikoff, I. J., and D. H. Lee. 1978. Table 1-3. In *Asbestos and Disease*. New York, NY: Academic Press. p. 18-18.

Smith, W. E. 1952. Survey of some current British and European studies of occupational tumor problems. *AMA Arch Ind Hyg Occup Med* 5 (3):242-63.

Stokinger, H. E. 1973. Memorandum re: "Identification of a threshold of response and estimations of safety factors in the present recommended standards for the industrial carcinogen, ASBESTOS." Department of Health, Education, and Welfare, Centers for Disease Control, NIOSH. August 8, 1973.

Stokinger, H. E. 1981. Threshold limit values In *Dangerous Properties of Industrial Materials*, edited by H. E. Stokinger. New York: Van Nostrand Reinhold. p. 8-13.

Teta, M. J., P. J. Mink, E. Lau, B. K. Sceurman, and E. D. Foster. 2008. US mesothelioma patterns 1973-2002: Indicators of change and insights into background rates. *European Journal of Cancer Prevention* 17 (6):525-34.

U.S. Department of Labor. 1942. Basic Safety and Health Requirements for Establishments Subject to Walsh-Healey Public Contracts Act. Washington, D.C.: U.S. GPO.

U.S. Department of Labor. 1952. Safety and Health Standards for Contractors Performing Federal Supply Contracts Under the Walsh- Healey Contracts Act, Wage and Hour and Public Contracts Division. Washington, D.C.: DC: U.S. Government Printing Office.

U.S. Department of Labor, W. a. H. a. P. C. D. W. 1936. Chapter 881. Volume XLIX in two parts. Part 1: Public acts and resolutions. In *Statutes at Large of the United States of America from January 1935 to June 1936: Concurrent Resolutions Recent Treaties and Conventions, Executive Proclamations and Agreements*. Washington, D.C.: United States Department of Labor, Wage and Hour and Public Contracts Divisions. p. 2036-2040.

U.S. Navy. 1945. Bureau of Ships Manual: Thermal Insulation, Chapter 39. NAVSHIPS 250-0000(39). Washington D.C. NAVSHIPS 250-0000(39). Washington, D.C.: U.S. Navy, Bureau of Ships. p. 1-35.

U.S. Navy. 1947. Bureau of Ships Manual: Chapter 39: Thermal Insulation. Washington, D.C.: U.S. Navy, Bureau of Ships.

U.S. Navy. 1959a. Bureau of Ships Technical Manual: Chapter 39, Thermal Insulation. NAVSHIPS 250-000. 15 April 1959. Washington, D.C.: U.S. Navy, Bureau of Ships.

U.S. Navy. 1959b. Military Specification: Insulation Felt, Thermal, Asbestos Fiber for MIL-I-0015091B (SHIPS).

U.S. Navy. 1960. Bureau of Ships Technical Manual, Vol. I: Thermal Insulation, Chapter 39. Washington, D.C.: U.S. Navy, Bureau of Ships. p. 1-155.

U.S. Navy. 1962. Military Specification: Insulation Felt, Thermal, Asbestos Fiber for MIL-I-15091C.

U.S. Navy. 1965. Bureau of Ships Technical Manual: Chapter 9390, Thermal Insulation. NAVSHIPS 250-000. November 1, 1965. Washington, D.C.: U.S. Navy, Bureau of Ships.

U.S. Navy. 1966. Bureau of Ships Technical Manual: Chapter 9390, Thermal Insulation. NAVSHIPS 250-000. January 15, 1966. Washington, D.C.: U.S. Navy, Bureau of Ships.

United States 91st Congress. 1970. Occupational Safety and Health Act of 1970. Public Law 91-596. Washington, D.C.: U.S. Government Printing Office.

United States Navy. 1955. BUMED Instruction 62.70.3., edited by the Bureau of Medicine and Surgery. November 7, 1955. p. 1-4.

Unknown. 1934. Asbestos umbrella protects firemen. *Popular Science Monthly* 125 (4):30-30.

USEPA. 1986a. Airborne asbestos health assessment update. EPA/600/8-84/003F. June 1986. Washington, D.C.: U.S. Environmental Protection Agency, Office of Health and Environmental Assessment.

USEPA. 1986b. Guidelines for Carcinogen Risk Assessment. Published on September 24, 1986, Fed. Reg. 51(185): 33992-34003. EPA/630/R-00/004. September 1986. Washington, D.C.: Risk Assessment Forum, U.S. Environmental Protection Agency.

USEPA. 2005. Guidelines for Carcinogen Risk Assessment. EPA/630/P-03/001F. March 2005. Washington, D.C.: Risk Assessment Forum, U.S. Environmental Protection Agency.

USEPA. 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-090/052F. September 2011. Washington, D.C.: National Center for Environmental Assessment, Office of Research and Development.

USEPA. 2017. Risk Assessment for Carcinogenic Effects. United States Environmental Protection Agency, January 31, 2017 [cited June 28, 2017]. Available from https://www.epa.gov/fera/risk-assessment-carcinogenic-effects.

Viet, S. M., M. Stenzel, C. Rennix, T. Armstrong, and J. Couch. 2008. Guideline on Occupational Exposure Reconstruction. 1st Edition. Fairfax, VA: American Industrial Hygiene Association Press.

Virta, R. L. 2005. Mineral Commodity Profiles: Asbestos. USGS Circular 1255-KK. Washington, D.C.: U.S. Department of the Interior, U.S. Geological Survey.

Vorwald, A. J., T. M. Durkan, and P. C. Pratt. 1951. Experimental studies of asbestosis. *AMA Arch Ind Hyg Occup Med* 3 (1):1-43.

Wagner, J. C. 1965. Epidemiology of diffuse mesothelial tumors: Evidence of an association from studies in South Africa and the United Kingdom. *Annals of the New York Academy of Sciences* 132 (1):575-8.

Wagner, J. C., C. A. Sleggs, and P. Marchand. 1960. Diffuse pleural mesothelioma and asbestos exposure in the North Western Cape Province. *British J Ind Med* 17:260-71.

Wedler, H. W. 1943a. Asbestose und Lungenkrebs [Asbestosis and Lung Cancer]. *Deutsche Medizinische Wochenschrift* 69:575-576.

Wedler, H. W. 1943b. Uber den lungenkrebs bei asbestose [Lung Cancer in Asbestosis Patients]. *Dtsch. Arch. Klin. Med.* 191:189-209.

Williams, P. R., J. Sahmel, J. Knutsen, J. Spencer, and A. L. Bunge. 2011. Dermal absorption of benzene in occupational settings: estimating flux and applications for risk assessment. *Crit Rev Toxicol* 41 (2):111-42.

Attachment A

Curriculum Vitae

Jennifer Sahmel, MPH, CIH, CSP, FAIHA
Managing Principal Scientist
Insight Exposure & Risk Sciences
1790 38th Street, Suite 100
Boulder, CO 80301
(720) 287-3441 office
(303) 906-7025 mobile
jennifer.sahmel@insightrisk.com
www.insightrisk.com

Professional Profile

Ms. Sahmel is a certified industrial hygienist and certified safety professional with over 20 years of experience in human health risk assessment and workplace health and safety. She is also a Fellow of the American Industrial Hygiene Association (FAIHA) and a Research Fellow of the Exposure Science and Sustainability Institute at the University of Minnesota. She has significant experience in exposure assessment practice and methodologies, exposure reconstruction, health risk decision making, OSHA regulatory issues, and safety management systems. Her areas of expertise include comprehensive exposure and risk assessment strategies, exposure reconstruction, dermal exposure assessment methods, industrial hygiene state of knowledge, Bayesian decision analysis, U.S. EPA exposure assessment tools, Proposition 65 health risk assessment, product stewardship and sustainability issues, industrial hygiene monitoring and data analysis, safety and occupational health management methods, and safety leadership. Ms. Sahmel has been involved in characterizing exposure to a variety of chemicals and products for both occupational and consumer product exposure scenarios in a variety of circumstances including for government, academia, law firms, non-profit associations, and private companies. These substances include asbestos, talc, solvents, benzene, gasoline, flame retardants, wood dust, phthalates, lead, beryllium, silica, vinyl chloride, paints/coatings, boiler water treatments, organic solvents, abrasive blasting agents, mercury, arsenic, carbon monoxide, and others.

Education and Degrees Earned

University of Minnesota, Twin Cities, 2013-present
- Environmental Health Sciences, PhD program. Estimated completion 2020.

M.P.H., Industrial Hygiene, University of California, Berkeley, 1996
University of Maryland, College Park, MD, 1992-1994
- Coursework included General Chemistry I and II, Organic Chemistry, Microbiology, Multivariable Calculus, and Differential Equations. Total of 24 semester credit hours.

B.A., International Studies, College of William and Mary, Williamsburg, VA, 1992
- Completed studies at the Université de Grenoble in Grenoble, France in 1991

Certifications

Certified Industrial Hygienist, #8035, 2000 (re-certified 2016)
Certified Safety Professional, #31110, 2004 (re-certified 2016)

Professional Honors/Awards

- Awarded Fellow status in the American Industrial Hygiene Association (FAIHA), 2019

- Research Fellow, Exposure Science and Sustainability Institute, University of Minnesota, 2018 – present.

- Elected to the American Industrial Hygiene Association's Board of Directors in 2014. Served as a Director for the nearly 10,000-member organization for 2014-2017.

- Presented with the American Industrial Hygiene Association's (AIHA's) Outstanding Group Contributor Award in 2013.

- Presented with the American Industrial Hygiene Association's (AIHA's) Outstanding Individual Contributor Award in 2010.

- Presented an Outstanding Poster Award, Occupational and Environmental Exposure of the Skin to Chemicals Conference (OEESC) 2007, Golden, Colorado, for "A Screening Method for Prioritizing Dermal Exposure Concerns Within the AIHA Strategy for Assessing and Managing Occupational Exposures".

- Awarded an EPA Bronze Medal in 2002 for work on a Design for Environment project to help businesses improve environmental and occupational safety and health conditions in auto refinishing shops nationwide.

- Awarded two EPA Bronze Medals in 2001 for significant contributions to a project to control safety and health concerns related to the use of acrylamide products and for significant contributions to the EPA Counter-Terrorism Taskforce.

- Awarded a 1996 Semiconductor Safety Association (SSA) national scholarship for graduate study and research in Industrial Hygiene. Resulting research was published in the Semiconductor Safety Association Journal.

- Awarded two National Institute for Occupational Safety and Health (NIOSH) Training Grants (1995 and 1996) for graduate study in industrial hygiene.

Professional Associations

American Industrial Hygiene Association (AIHA), Full Member
American Conference of Governmental Industrial Hygienists (ACGIH), Full Member
International Society for Exposure Science (ISES), Full Member
Society of Toxicology (SOT), Full Member
Society for Risk Analysis (SRA), Full Member

Science Advisory Groups

Co-Chair, National Institute for Occupational Safety and Health (NIOSH)-facilitated National Occupational Research Agenda (NORA) Cross-Sector Council for Immune, Infectious, and Dermal Disease. NORA is a partnership program to stimulate innovative research and improved workplace practices. Diverse parties collaborate to identify the most critical issues in workplace safety and health and then make progress on those issues through information sharing, collaboration, and enhancing dissemination and implementation of evidence-based practices. 2016 – present.

Subject Expert Workgroup Member, NIOSH Expert Workgroup on Skin Notations and Dermal Exposure Issues. This expert working group was a collaborative effort between NIOSH scientists and external subject matter experts in the fields of toxicology, industrial hygiene, occupational medicine, epidemiology and dermatology to address scientific issues associated with the assignment of hazard-specific skin notations, 2005 - 2009.

Member, International Standards Organization (ISO) Technical Committee 146, Subcommittee 2, Workgroup 8, Air Quality – Workplace Atmospheres – Assessment of Contamination of Skin and Surfaces from Airborne Chemicals, 2006 - present. The primary objectives of this workgroup are to harmonize dermal exposure assessment terminology and to provide internationally standardized tools to assess dermal exposure. The group works closely with the European Committee for Standardization (CEN) TC137 WG6 (Assessment of Workplace Exposure to Chemical and Biological Agents – Dermal Exposure.

Professional Experience

Insight Exposure and Risk Sciences, Inc. (2017 – present)

- Perform human health exposure and risk assessments for clients related to a number of different agents in a variety of scenarios, including for occupational, consumer, and public exposures.

Insight Risk (2018 – 2019)

- Managing Principal Scientist dedicated to addressing scientifically complex and technical questions related to human health and safety, including exposure and risk assessment.

- Specialized in addressing the disciplines of industrial hygiene, exposure science, occupational and consumer exposure assessment, and exposure reconstruction.

Cardno ChemRisk, LLC (2007 – 2017)

- Evaluated take home and bystander asbestos exposure potential associated with the use of encapsulated chrysotile-containing products.

- Conducted a risk assessment for alternative abrasive blasting agents using recycled materials. Also conducted a warnings and MSDS evaluation for abrasive blasting agents and conducted a risk assessment comparison between alternative and traditional silica-based abrasive blasting agents.

- Conducted a large ongoing risk assessment for a chemical company that involves detailed negotiations with a state environmental agency to achieve a mutually agreeable risk management plan.

- Conducted a risk assessment for dermal exposures to chemicals in water and soil for a large construction project in Toronto, Canada.

- Conducted a Proposition 65 risk assessment to evaluate the potential health risks associated with the use of a non-prescription cosmetic fade cream containing hydroquinone. Modeled dermal uptake based on expected use of the product.

- Conducted an assessment of bystander exposures to the use and manipulation of asbestos containing products in steel mills.

- Conducted an exposure assessment for the occupational use of a new chemical not listed previously on the TSCA inventory. Provided recommendations for safe use and disposal of the chemical.

- Conducted a Proposition 65 assessment of the potential for exposure to phthalates in a kitchen utensil. Assessed dermal and potential ingestion exposure potential for both adults and children.

- Conducted a comprehensive analysis of personal and area benzene exposures at a large chemical plant over a 40-year period. Developed a formal retrospective exposure assessment by division, department, and job title for the entire facility. Used statistical techniques and Bayesian Decision analysis to generate exposure values. Also provided individual exposure estimates where applicable as well as detailed information on facility corporate conduct.

- Conducted a Proposition 65 assessment of a consumer product mechanical gauge composed of brass with chrome plating to determine the potential for dermal, hand to mouth, or ingestion exposure to lead in the chrome.

- Conducted a Proposition 65 assessment of a consumer product packaging containing cadmium in the label. Determined the potential for dermal, hand to mouth, or ingestion exposure to cadmium in the package label.

- Evaluated airborne asbestos exposures associated with multiple scenarios, including auto repair, exposures to gaskets and packing, bystander exposure during a wide variety of tasks, and during television repair.

- Conducted an exposure assessment associated with the presence of benzene in construction products, including framing adhesives. Assessed the potential for both dermal and inhalation exposures to benzene through consumer and occupational use of the products.

- Conducted a risk assessment to assess compliance with Proposition 65 and the California Safe Cosmetics Act for a cosmetic fingernail adhesive product. The comprehensive risk assessment included estimates of daily exposure associated with both consumer and occupational uses of the product via the inhalation, dermal, and ingestion routes of exposure.

- Conducted an exposure reconstruction for benzene exposure at multiple chemical plants and petrochemical refineries associated with pipefitting and repair work.

- Conducted a comprehensive exposure assessment for occupational exposures to benzene in spray paint products. Used product information, published literature, and exposure data to develop exposure estimates for benzene associated with specific occupational scenarios.

- Conducted an exposure analysis of vinyl chloride in consumer products. Developed a detailed modeling assessment of exposures for a variety of specific use scenarios. Applied both transient two-zone and steady state models, as well as Monte Carlo sensitivity analysis techniques.

- Conducted California Proposition 65 and Consumer Product Safety Commission health risk assessments for multiple types of jewelry products manufactured from different types of materials, including metal and nonmetal components. Estimated the total potential bodily dose of lead based on contact with selected products via dermal absorption, hand to mouth exposure, mouthing (oral) exposure and ingestion for both adults and children. Evaluated laboratory standards and results from testing conducted using Prop 65, Consumer Product Safety Commission (CPSC), and Health Canada

standards. Determined both total and soluble/accessible lead content in the products, and employed modeling techniques to determine cumulative exposure potential.

- Conducted a simulation study to assess airborne exposures to carbon monoxide during recreational vehicle use, including quantification of exposure zones, determination of exposure gradients and decay, and evaluation of multiple use scenarios.

- Evaluated dermal and inhalation exposures to solvent-based paints and coatings associated with pipe repair and other industrial applications.

- Evaluated the potential for mercury exposure associated with manometers used in natural gas pipe repair and installation.

- Evaluated the potential for occupational exposures to boiler water treatments at an industrial facility.

U.S. Department of the Interior, National Park Service (2003 – 2007)

- Conducted exposure assessments and personal exposure monitoring for the Intermountain Region of the National Park Service. Conducted comprehensive evaluations for carbon monoxide exposures for employees in boating operations, noise exposures during heavy equipment operation and shop work, silica exposures during generator-powered rock-drilling, diesel exposures in high vehicle traffic areas, wood dust exposures during carpentry and trails work, arsenic exposures during work in former mining areas, and indoor air quality.

- Developed a medical monitoring program for arsenic for the Intermountain Region. Defined the program requirements, communicated them with regional personnel, and analyzed all biological monitoring data obtained to ensure compliance with the program.

- Developed a database to track comprehensive exposure assessment information for all Intermountain Regional activities and work tasks for the National Park Service. Database parameters included monitoring data, modeling results, and qualitative assessment information.

- Managed the Intermountain Regional safety and health program for 89 parks and over 5,400 employees and volunteers for the National Park Service. Conducted technical safety and health program management evaluations, including safety and health field site visits. Reduced total employee injuries and illnesses in the region by 20% from 2005 to 2007, allowing for an estimated regional cost savings of over $600,000. Guided specific safety management systems in the region, including top management safety

leadership and direction, safety accountability systems, audit systems, hazard control planning, and incident investigation.

- Initiated an Intermountain Regional safety newsletter and periodic conference call program to interact regularly with all park Collateral-Duty Safety Officers and to provide important safety information and updates on program priorities. Developed and presented service-wide National Park Service training in satellite television format on Personal Protective Equipment in February 2005. Developed and presented Intermountain Regional training on a number of subjects, including Infectious Diseases, Ergonomics and OSHA Recordkeeping/Form 300 Requirements.

U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics (2000 – 2003)

- Conducted chemical-specific comprehensive exposure assessments for a wide range of substances, including acrylamide, brominated flame retardants, methyl tert-butyl ether (MTBE), perfluorooctane sulfonate (PFOS), and perfluorooctanoic acid (PFOA).

- Provided professional industrial hygiene and safety engineering expertise on a number of key national programs at the U.S. Environmental Protection Agency, including the Toxic Substances Control Act regulatory activities, High Production Volume Chemicals, International Screening Information Data Sets, Pollution Prevention, Green Engineering, Design for the Environment, the Voluntary Children's Chemical Evaluation Program (VCCEP) and others.

- Worked to evaluate and enhance many exposure assessment tools, models, and methodologies, including the Chemical Screening Tool for Exposures and Environmental Releases (ChemSTEER), generic scenarios for industry-specific workplace release and exposure estimation, and tiered exposure assessment guidelines.

- Developed and wrote policy and program guidelines on chemical exposure and safety issues, including respirator cartridge evaluation and testing, particulate exposures and evaluation, dermal exposure assessment and glove permeation evaluation, and engineering controls in the workplace.

- Served as joint manager of the New Chemical Exposure Limit (NCEL) investigation and compliance team, which developed strategies and executed inspections to ensure compliance with the inhalation exposure limit requirements for substances regulated under TSCA 5(e). Developed a comprehensive database to rate and prioritize substances with assigned NCEL values as potential inspection targets.

- Conducted frequent engineering assessments of new chemicals as part of the evaluation of substances for inclusion on the TSCA inventory list. Used modeling and other tools to conduct human exposure and environmental release assessments, providing in-depth

analysis and guidance where necessary. Participated in the TSCA regulatory process for certain substances with identified health risks. Employed requirements as necessary of such related regulations as CERCLA and RCRA as well as OSHA and National Institute of Occupational Safety and Health (NIOSH) guidelines and regulations.

- Served as the technical industrial hygiene liaison for the office to outside agencies, including OSHA, NIOSH, and the Mine Safety and Health Administration (MSHA) on occupational safety and human health issues.

- Provided industrial hygiene and exposure control expertise to the OPPT counter terrorism workgroup. Workgroup activities have included developing appropriate emergency protection and controls to be used with lists of specific TSCA chemicals with the potential to be used as terrorist weapons.

<u>Comprehensive Health Services, Inc., NASA Goddard Space Flight Center (1996 – 2000)</u>

- While working at NASA's Goddard Space Flight Center (GSFC), evaluated airborne and dermal chemical exposure concerns during semiconductor chip fabrication, space materials research, and use of rocket fuels. Assessed noise/vibration exposures during launch simulations. Also managed the Hearing Conservation, Respiratory Protection, Ergonomics, and Local Exhaust Ventilation Monitoring Programs. Developed, maintained, and provided training for occupational health programs. Prepared and collected information for use in Goddard Space Flight Center's application for certification under OSHA's Voluntary Protection Program.

- Created, managed, and maintained a large relational Microsoft Access database to organize and store all of Goddard Space Flight Center's Industrial Hygiene, Health Physics, Medical Monitoring, and Fitness Program data for over 4,000 employees.

- Participated on the GSFC Emergency Response Team, and prepared for and responded to site emergencies, including medical emergencies, chemical emergencies, and other safety emergency situations. Also responded to and evaluated non-emergency individual employee health complaints and issues and provided appropriate evaluation and follow-up.

<u>FMC Corporation, Agricultural Products Division (1995 and 1996)</u>

- While working at FMC's Agricultural Products Division, provided industrial hygiene support to a large agricultural chemical manufacturing plant. Conducted a wide variety of industrial hygiene activities, including air monitoring, respiratory protection fit testing, wipe sampling, monitoring with direct reading instruments, illumination intensity monitoring, noise monitoring, and laboratory sample analysis.

- Assisted in the development of industrial hygiene protocols for a new process plant under construction at the site, including conducting research on the necessary personal protective equipment, air sampling protocols, and emergency response procedures.

- Participated on the committee for Maryland Environment 2000 to evaluate and prioritize environmental issues for the state of Maryland.

<u>Labor Occupational Health Program, University of California at Berkeley (1994-1996)</u>

- Worked as an Industrial Hygiene Technical Assistant at the University of California at Berkeley's Labor Occupational Health Program (LOHP). Interfaced with project coordinators, union officials, health and safety professionals, and the public on many specific industrial hygiene issues, including workstation ergonomic design, chemical exposures, magnetic field exposure, occupational asthma, and bioaerosol exposures. Developed industrial hygiene training programs for use by the project coordinators on such subjects as glove and respirator education and use.

<u>Professional Associations and Activities</u>

Member, AIHA Exposure Assessment Strategies Committee, 2001-present.

Member, AIHA Risk Assessment Committee, 2017-present.

Full Member, American National Standards Institute (ANSI) Z88 Respiratory Protection and Standards Development Committee, 2000-2017.

Member, AIHA Engineering Committee, 2004-2009.

Instructor, American Industrial Hygiene conference and exposition (AIHce) and Professional Conference on Industrial Hygiene (PCIH) Professional Development Courses: Evaluation and Control of Dermal Exposures, 2003, 2005, 2006 and 2010, 2019

Instructor, AIHce Professional Development Course: Exposure Assessment Strategies and Statistics Professional Development Course, various years 2005-2019

Instructor, AIHce Professional Development Course: Mathematical Modeling for Occupational Exposure Assessment, 2008-2014.

Instructor, AIHce Professional Development Course: Professional Judgment in Industrial Hygiene, 2010-2014.

Advisory Board Member and Attendee, AIHA Future Leaders Institute, 2005 and 2008.

Chair, American Industrial Hygiene Association (AIHA) Exposure Assessment Strategies Committee, 2006. Oversaw publications, training, and other activities of a well-respected committee of safety and health professionals in developing best practices for safety and health exposure assessment methods, statistical evaluation, and modeling strategies. Served as Secretary in 2004 and Vice-Chair in 2005.

Founder and Chair, AIHA Exposure Assessment Strategies Committee, Subcommittee for Dermal Exposure Assessment, 2001-2005. Subcommittee member, 2001- present.

Conference Co-Chair, Occupational and Environmental Exposures of the Skin to Chemicals (OEESC) Conference 2007, held June 17-20, 2007 in Golden, CO. Biennial conference of occupational and environmental health professionals, dermatologists, policy-makers and others to help address the science, knowledge gaps, future challenges, and policy opportunities related to occupational and environmental exposures of the skin to chemicals. OEESC 2007 followed previous successful conferences in Washington, DC in 2002 and Stockholm, Sweden in 2005. Primary sponsors of the conference included the National Institute for Occupational Safety and Health (NIOSH), the U.S. Environmental Protection Agency (EPA), and the AIHA.

<u>Publications</u>

Burns, A.M., Barlow, C.A., Banducci, A.M., Unice, K.M., **J. Sahmel**. 2019. Potential Airborne Asbestos Exposure and Risk Associated with the Historical Use of Cosmetic Talcum Powder Products. Risk. Anal. Advance online publication, April 12, 2019. dOI: 10.1111/risa.13312.

Avens, H.J., J.R. Maskrey, A.L. Insley, K.M. Unice, R.C.D. Reid, **J. Sahmel**. 2018. Characterization of airborne BTEX exposures during use of lawnmowers and trimmers. Arch. Env Occup Health. Advance online publication, Jan. 10, 2018. doi: 10.1080/19338244.2018.1426552.

Glynn, M.E., K.A. Keeton, S.H. Gaffney, and **J. Sahmel.** 2018. Ambient asbestos fiber concentrations and long-term trends in pleural mesothelioma incidence between urban and rural areas in the United States (1973-2012). Risk Anal. 38(3):454-471.

Barlow, C.A., **J. Sahmel**, D.J. Paustenbach, and J.L. Henshaw. 2017. History of knowledge and evolution of occupational health and regulatory aspects of asbestos exposure science: 1900-1975. Crit Rev Tox. 47(4):1-31.

Sahmel, J., C.A. Barlow, S. Gaffney, H.J. Avens, A.K. Madl, J. Henshaw, K. Unice, D. Galbraith, G. DeRose, R.J. Lee, D. Van Orden, M. Sanchez, M. Zock, and D.J. Paustenbach. 2016. Airborne asbestos take-home exposures during handling of chrysotile-contaminated clothing following simulated full shift workplace exposures. J Exp Sci Environ Epidemiol 26:48-62.

Sahmel, J., H.J. Avens, P.K. Scott, K. Unice, A. Burns, C.A. Barlow, A.K. Madl, J. Henshaw, and D.J. Paustenbach. 2015. Measured removal rates of chrysotile asbestos fibers from air and

comparison with theoretical estimates based on gravitational settling and dilution ventilation. Inhal Tox. 27(14):787-801.

Cowan D.M., T.J. Cheng, M. Ground**, J. Sahmel**, A. Varughese, and A.K. Madl. 2015. Analysis of workplace compliance measurements of asbestos by the U.S. Occupational Safety and Health Administration (1984-2011). Reg Tox Pharm. 72:615-629.

Sahmel, J., E.I. Hsu, H.J. Avens, E.M. Beckett, and K.D. Devlin. 2015. Estimation of hand-to-mouth transfer efficiency of lead. Ann Occup Hyg. 59(2):210-20.

Gauthier, A.M., M. Fung, J. Panko, T. Kingsbury, A.L. Perez, K. Hitchcock, T. Ferracini, **J. Sahmel,** A. Banducci, M. Jacobsen, A. Abelmann, and E. Shay. 2015. Chemical assessment state of the science: Evaluation of 32 decision-support tools used to screen and prioritize chemicals. Integr Env Assess Mgmt. 11(2):242-255.

Banerjee, S., G. Ramachandran, M. Vadali, and **J. Sahmel**. 2014. Bayesian hierarchical framework for occupational hygiene decision making. Ann Occup Hyg. 58(9):1079-1093.

Sahmel, J., C.A. Barlow, B. Simmons, S.H. Gaffney, H.J. Avens, A.K. Madl, J. Henshaw, R.J. Lee, D. Van Orden, M. Sanchez, M. Zock, and D.J. Paustenbach. 2014. Evaluation of take-home exposure and risk associated with the handling of clothing contaminated with chrysotile asbestos. Risk Anal. 34(8):1448-68.

Cyrs, W.D., H.J. Avens, Z.A. Capshaw, R.A. Kingsbury, **J. Sahmel**, and B.E. Tvermoes. 2014. Landfill waste and recycling: Use of a screening-level risk assessment tool for end-of-life cadmium telluride (CdTe) thin-film photovoltaic (PV) panels. Energ. Policy. 68:524-533.

Sahmel, J., S. Gaffney, J. Knutsen, B. Epstien, and D. Paustenbach. 2014. Determinants of carbon monoxide exposure inside a motor home during on-board generator use. Int J Vehicle Safety. 7(3-4):409-424.

Sahmel, J., K. Devlin, A. Burns, T. Ferracini, M. Ground, and D. Paustenbach. 2013. An analysis of workplace exposures to benzene over four decades at a petrochemical processing and manufacturing facility (1962-1999). J Tox Env Health A. 76(12):723-746.

Frasch, F.H., Dotson, S.G., Bunge, A.L., Chen, C.P., Cherrie, J.W., Kasting, G.W., Kissel, J., **Sahmel, J.**, Semple, S. and Wilkinson, S. 2013. Analysis of finite dose dermal absorption data: Implications for dermal exposure assessment. J Expo Sci Environ Epidemiol. 24(1):65-73.

Gross S.A., H.J. Avens, A.M. Banducci, **J. Sahmel**, J.M. Panko, and B.E. Tvermoes. 2013. Analysis of BTEX groundwater concentrations from surface spills associated with hydraulic fracturing operations. Journal of the Air & Waste Management Association, 63(4):424–432.

Hollins, D.M., B.D. Kerger, K.M. Unice, J.S. Knutsen, A.K. Madl, **J. Sahmel**, and D.J. Paustenbach. 2013. Airborne benzene exposures from cleaning metal surfaces with small volumes of petroleum solvents. Int J Hyg Env Health. 216(3):324-332.

Avens H.J., K.M. Unice, **J. Sahmel,** S.A. Gross, J.J. Keenan, and D.J. Paustenbach. 2011. Analysis and modeling of airborne BTEX concentrations from the Deepwater Horizon Oil Spill. Environ Sci Tech. 45 (17):7372–7379.

Williams P.R.D., **J. Sahmel**, J.S. Knutsen, J. Spencer and A.L. Bunge. 2011. Dermal Absorption of Benzene in Occupational Settings: Estimating Flux and Applications for Risk Assessment. Crit Rev Toxicol. 41(2):111-142.

Donovan E.P., B.L. Donovan, **J. Sahmel**, P.K. Scott, and D.J. Paustenbach. 2011. Evaluation of bystander exposures to asbestos in occupational settings: A review of the literature and application of a simple eddy diffusion model. Crit Rev Toxicol. 41(1):52-74.

Cowan, D.M., P. Dopart, T. Ferracini, **J. Sahmel**, K. Merryman, S. Gaffney and D.J. Paustenbach. 2010. A cross-sectional analysis of reported corporate environmental sustainability practices. Reg Tox Pharmacol. 58(3):524-538.

Sahmel, J., K.D. Devlin, D.J. Paustenbach, D.M. Hollins, and S.H. Gaffney. 2010. The role of exposure reconstruction in occupational human health risk assessment: Current methods and a recommended framework. Crit Rev Toxicol. 40(9):799-843.

Paustenbach, D.J., J.S. Knutsen, D.M. Hollins, **J. Sahmel**, and A.K. Madl. 2010. Comparison of modeled and measured concentrations of airborne benzene from the use of petroleum-based solvents spiked with low levels of benzene. Chem-Biol Interact. 184(1-2):296-298.

Sahmel, J., K.M. Unice, P.K. Scott, D.M. Cowan and D.J. Paustenbach. 2009. The Use of Multizone Models to Estimate an Airborne Chemical Contaminant Generation and Decay Profile: Occupational Exposures of Hairdressers to Vinyl Chloride in Hairspray during the 1960s and 1970s. Risk Analysis. 29(12):1699-1725.

Sahmel Faraci, J. and M.E. Williams. 1998. Fabrication-Area Ergonomic Control Practices in the US Semiconductor Industry. Semiconductor Safety Association Journal. 12:33-44.

<u>Book Chapters</u>

Sahmel, J. 2015. Dermal Exposure Assessments. Chapter 13. In: A Strategy for Assessing and Managing Occupational Exposures, 4th ed. Ignacio and Bullock (eds). American Industrial Hygiene Association, Fairfax, VA.

Boeniger, M., **J. Sahmel**, R. Roy, and J. Walton. 2015. Dermal Exposure Assessment Methods. Appendix II. In: A Strategy for Assessing and Managing Occupational Exposures, 4th ed. Ignacio and Bullock (eds). American Industrial Hygiene Association, Fairfax, VA.

Sahmel, J., D.M. Cowan, J.M. Panko and D.J. Paustenbach. 2012. Future Trends in Risk Management: Control Banding and REACH. Chapter 19 in: Perkins, J. and Gray, C. (eds). Modern Industrial Hygiene, Volume III: Control of Chemical Agents, Part IV: Risk Management. ACGIH: Cincinnati, OH, pp. 727-764.

Paustenbach, D.J., D.M. Cowan and, **J. Sahmel.** 2011. Chapter 20: The history and biological basis of occupational exposure limits for chemical agents. In: Rose, V.E. and B. Cohrssen B (eds.), *Patty's Industrial Hygiene*. Sixth edition. Wiley & Sons, New York, pp. 865-954.

Gaffney S.H., **J. Sahmel**, K.D. Devlin and D.J. Paustenbach. 2010. Exposure Reconstruction and Cancer Risk Estimate Derivation. Chapter 30 in: Hsu C and Stedeford T (eds). Cancer Risk Assessment: Chemical Carcinogenesis, Hazard Evaluation, and Risk Quantification. Hoboken, NJ: John Wiley and Sons, pp. 736-784.

Sahmel, J., M. Boeniger, J.S. Knutsen,W. ten Berge and M.C. Fehrenbacher. 2009. Dermal Exposure Modeling. Chapter 13, pp. 105-132, In: Mathematical Models for Estimating Occupational Exposure to Chemicals, 2nd ed. Keil C, Simmons, C and Anthony, R., eds. Fairfax, VA: American Industrial Hygiene Association Press.

Sahmel, J. and M. Boeniger. 2006. Dermal Exposure Assessments. Chapter 12, pp.137-161. In: A Strategy for Assessing and Managing Occupational Exposures, 3rd ed. Ignacio and Bullock (eds). American Industrial Hygiene Association, Fairfax, VA.

Boeniger, M., **J. Sahmel** and C. Fehrenbacher. 2006. Dermal Exposure Assessment Methods. Appendix II, pp. 305-333. In: A Strategy for Assessing and Managing Occupational Exposures, 3rd ed. Ignacio and Bullock (eds). American Industrial Hygiene Association, Fairfax, VA.

Invited Scientific Lectures and Presentations

Sahmel, J. 2019. Dermal Exposure Assessment: Quantitative Dermal Transfer Efficiencies for Assessment of Multiple Compartment Transfer Pathways. Occupational and Environmental Exposure of the Skin to Chemicals. September 16-18, 2019, Dublin, Ireland.

Sahmel, J. 2019. What is Total Worker Exposure, and Why Is It Important to the Practice of Occupational and Industrial Hygiene? Roundtable presentation at the American Industrial Hygiene Conference and Exposition. May 20-22, 2019, Minneapolis, MN.

Sahmel, J. 2018. Skin Matters: Absorption, Sensitization, and Transfer Efficiencies. Roundtable presentation at the American Industrial Hygiene Conference and Exposition. May 21-23, 2018, Philadelphia, PA.

Sahmel, J. 2016. Skin Hydration Measurement Techniques. Roundtable presentation at the American Industrial Hygiene Conference and Exposition. May 21-26, 2016, Baltimore, MD.

Sahmel, J. 2016. Research Update on the AIHA Content Priorities. Presentation at the American Industrial Hygiene Conference and Exposition. May 21-26, 2016, Baltimore, MD.

Sahmel, J. 2015. Exposure Assessment Tools for the Industrial Hygienist. 1st China/U.S. OH Symposium. September, 2015, Shanghai, China.

Sahmel, J. 2014. Dermal Exposure Judgment. J. Sahmel, Cardno ChemRisk, Inc., Boulder, CO. Roundtable presentation at the American Industrial Hygiene Conference and Exposition. May 31 – June 5, 2014, San Antonio, TX.

Sahmel, J. 2014. Industrial Hygiene Decision Making for Dermal Exposure Scenarios. J. Sahmel, Cardno ChemRisk, Inc., Boulder, CO. Science Symposium at the American Industrial Hygiene Conference and Exposition. May 31 – June 5, 2014, San Antonio, TX.

Sahmel, J. 2013. A Case Study Using a Decision Logic for Qualitative Dermal Exposure Assessment: Dermal Phenol Exposure Potential in a Phenolic Resin Molding Operation Occupational and Environmental Exposures of Skin to Chemicals (OEESC), June 2-5, 2013, Amsterdam, Netherlands.

Sahmel, J. 2013. Measurement of Airborne Asbestos Fiber Settling Rates in a Simulation Study of Clothes Handling. Podium presentation at the American Industrial Hygiene Conference and Exposition. May 18 - 23, 2013, Montreal, Canada.

Sahmel, J. 2013. Evaluation of Potential Take Home Exposure during Laundering Activities: A Simulation Study of Airborne Chrysotile Associated with Handling Clothing Exposed to Known Airborne Asbestos Concentrations. Podium presentation at the American Industrial Hygiene Conference and Exposition. May 18 - 23, 2013, Montreal, Canada.

Sahmel, J. 2013. A Case Study Using the AIHA Decision Logic for Qualitative Dermal Exposure Assessment: Dermal Phenol Exposure Potential in a Phenolic Resin Molding Operation. Roundtable presentation at the American Industrial Hygiene Conference and Exposition. May 18 - 23, 2013, Montreal, Canada.

Sahmel, J. 2012. Dermal Exposure and Risk Assessment: Developing a Structured Approach. AIHA Minnesota Local Chapter Professional Development Course, October 2, 2012. White Water, WI.

Sahmel, J. 2011. Dermal Exposure and Risk Assessment: Developing a Structured Approach. AIHA Minnesota Local Chapter Professional Development Course, November 16-18, 2011. St. Paul, MN.

Sahmel, J. 2010. The Role of Exposure Reconstruction in Occupational Human Health Risk Assessment: Current Methods and a Recommended Framework. Abstract M3-E.2 at the Society for Risk Analysis 2010 Annual Meeting. December 5-8, 2010, Salt Lake City, UT.

Sahmel, J. 2010. Dermal Exposure and Risk Assessment: Developing a Structured Approach. 49th Navy and Marine Corps Public Health Conference, March 19-25, 2010. Hampton, VA.

Sahmel, J. 2009. The Use of Bayesian Techniques in Retrospective Exposure Assessment: Case Study at a Chemical Manufacturing Facility. Abstract 173 in Podium Session 126 at the American Industrial Hygiene Conference and Exposition. May 31 – June 4, 2009, Toronto, Canada.

Sahmel, J. 2009. How do we try this at home? Dermal exposure assessment guidance and publications developed through AIHA for practicing industrial hygienists. Roundtable presentation at the American Industrial Hygiene Conference and Exposition. May 31 – June 4, 2009, Toronto, Canada.

Sahmel, J. 2008. The BEELs: Characterizing Total-Body Exposure to Chemicals, Expanding on the WEEL Model. J. Sahmel, ChemRisk, Inc., Boulder, CO. Roundtable presentation at the American Industrial Hygiene Conference and Exposition. May 31 – June 5, 2008, Minneapolis, MN.

Sahmel, J. 2008. A Qualitative Screening Method for Assessing Dermal Exposures in the Workplace. Podium Session 127 at American Industrial Hygiene Conference and Exposition. May 31 – June 5, 2008. Minneapolis, MN.

Sahmel, J. 2008. Exposure Assessment Strategies and Dermal Exposure Assessment. Florida AIHA Professional Development Conference. April 3-4, 2008, Jupiter, FL.

Sahmel, J. 2007. Management Systems for Occupational Health and Safety. Rocky Mountain AIHA Professional Development Conference. October 15-16, 2007, Arvada, CO.

Sahmel, J. 2007. Exposure Assessment Strategies and Dermal Exposure Assessment. NASA Occupational Health Conference, July 22-26, 2007.

Sahmel, J. 2007. Continuous Improvement as a Leadership Goal. Roundtable presentation at American Industrial Hygiene Conference and Exposition. June 2-7, 2007, Philadelphia, PA.

Sahmel, J. 2006. Dermal Exposure Assessment. Plenary Speaker at the Professional Conference on Industrial Hygiene. September 16-19, 2006. San Jose, CA.

Sahmel, J. 2005. Dermal Exposure Assessments. Speaker at the Professional Conference on Industrial Hygiene Symposium: Exposure Assessment Decision Making. Oct. 20-21, 2005. Denver, CO.

Sahmel, J. 2004. The Use of Biological Monitoring in Risk and Exposure Assessments. Roundtable presentation at American Industrial Hygiene Conference and Exposition. May 8-13, 2004. Atlanta, GA.

Sahmel, J. 2003. Qualitative Dermal Exposure Assessments. Speaker at the Professional Conference on Industrial Hygiene Symposium: Advanced Topics in Exposure Assessment. Sept. 13-16, 2003. Palm Springs, CA.

Sahmel, J. 2002. EPA's New Chemical Exposure Limit Program. Platform Presentation at the American Industrial Hygiene Conference and Exposition. June 1-6, 2002. San Diego, CA.

Sahmel, J. 2001. U.S. EPA Methods for Estimating Chemical Exposures. Platform Presentation at the American Industrial Hygiene Conference and Exposition. June 4-7, 2001. New Orleans, LA.

Sahmel, J. 2001. Ideology/Process of EPA in Exposure Limits. Roundtable at the American Industrial Hygiene Conference and Exposition. June 4-7, 2001. New Orleans, LA.

<u>Published Abstracts and Posters</u>

Gloekler, L.E., C.A. Barlow, B. Tvermoes, M.J. La Guardia, **J. Sahmel.** Characteristics of Flame Retardants in Baby Products and the Evaluation of Dermal Loading and Hand-to-Mouth Transfer Efficiency. SOT 57th Annual Meeting and ToxExpo. March 11-15, 2018.

Burns, A.M., K.M. Unice, A.M. Banducci, C.A. Barlow and **J. Sahmel**. 2017. Potential Airborne Asbestos Exposures Associated with the Historical Use of Cosmetic Talc Products. Abstract #1885. Poster Presentation at Society of Toxicology Annual Meeting. March 12-16, 2017. Baltimore, Maryland.

Sahmel, J., G. Ramachandran. 2016. Pilot Study: Quantitative Dermal Transfer Efficiencies for Assessment of Multiple Compartment Transfer Pathways. Accepted poster presentation at the Occupational and Environmental Exposures of Skin to Chemicals (OEESC), September 2016.

Glynn, M. E., K. A. Keeton, S. H. Gaffney, and **J. Sahmel.** 2016. Ambient asbestos and long-term trends in pleural mesothelioma incidence between urban and rural areas in the United States (1973 to 2012). Society of Toxicology Annual Meeting. (Accepted). March 13-17, 2016. New Orleans, Louisiana.

Sahmel, J., C.A. Barlow, B.L. Donovan, S.H. Gaffney, A.K. Madl, G.H. DeRose, R.J. Lee, D. Van Orden, and D.J. Paustenbach. 2012. Evaluation of Potential Take Home Exposure during

Laundering Activities: A Simulation Study of Airborne Chrysotile Associated with Handling Clothing Exposed to Known Airborne Asbestos Concentrations– Interim Results. International Society of Exposure Science (ISES) 22nd Annual Meeting. October 28- November 1, 2012. Seattle, WA.

Barlow, C.A., **J. Sahmel**, A.K. Madl, B.L. Donovan, S.H. Gaffney, A.M. Burns, R.J. Lee, D. Van Orden, and D.J. Paustenbach. 2012. Evaluation of Chrysotile Adherence to Clothing Exposed to Known Airborne Asbestos Concentrations and Subsequent to Vigorous Shaking. 2012 International Society of Exposure Science (ISES) 22nd Annual Meeting. October 28- November 1. Seattle, WA.

Sahmel, J., K.D. Devlin, A.M. Burns, T. Ferracini, M.D. Ground and D.J. Paustenbach. 2011. Analysis of Historical Industrial Hygiene Data: A Case Study Involving Benzene Exposures at a Petrochemical Manufacturing Facility (1974-1999). Abstract # 402-18. Poster presentation at the American Industrial Hygiene Conference & Exhibition (AIHce). May 14-19. Portland, OR.

Sahmel, J., K.M. Unice, P.K. Scott, D.M. Cowan, D and D.J. Paustenbach. 2008. Potential Occupational Exposures of Hairdressers to Vinyl Chloride in Hairspray. International Society for Exposure Assessment Conference, Pasadena, CA.

Sahmel, J. and M. Boeniger. 2007. A Screening Method for Prioritizing Dermal Exposure Concerns Within the AIHA Strategy for Assessing and Managing Occupational Exposures. Abstract #P87. Occupational and Environmental Exposures of Skin to Chemicals (OEESC) 2007 Abstract Book.

Attachment B

General Reference List

General Asbestos Reference List

Abelmann, A., M. E. Glynn, J. S. Pierce, P. K. Scott, S. Serrano, and D. J. Paustenbach. 2015. Historical ambient airborne asbestos concentrations in the United States - an analysis of published and unpublished literature (1960s-2000s). Inhalation Toxicology 27 (14):754-766.

Abrams, H. K. 1961. Occupational Health Hazards - Medical Aspects. In Volume 13, Labor Safety, Transactions of the National Safety Congress. Chicago, IL: National Safety Council, p. 5-12.

Abratt, R. P., D. A. Vorobiof, and N. White. 2004. Asbestos and mesothelioma in South Africa. Lung Cancer 45 Suppl 1:S3-6.

ACGIH (American Conference of Governmental and Industrial Hygenists). 1946. Proceedings of the Eighth Annual Meeting of the American Conferences of Governmental Industrial Hygienists. Chicago, IL: American Conferences of Governmental Industrial Hygienists. April 7-13, 1946.

ACGIH (American Conference of Governmental and Industrial Hygenists). 1998. Supplements to the Sixth Edition. Documentation of Threshold Limit Values and Biological Exposure Indices. Cincinnati, OH: American Conference of Governmental Industrial Hygienists (ACGIH), Committee on Threshold Limit Values.

ACGIH (American Conference of Governmental Industrial Hygenists). 1966. Documentation of Threshold Limit Values. Revised Edition. New York: American Conference of Governmental Industrial Hygienists.

ACGIH (American Conference of Governmental Industrial Hygienists). 1938-1970. Transactions of the First through Thirty-Second Annual Conference of Governmental Industrial Hygienists.

ACGIH (American Conference of Governmental Industrial Hygienists). 1946. Report of the sub-committee on threshold limits. Ann Am Conf Ind Hyg 9:343-480.

ACGIH (American Conference of Governmental Industrial Hygienists). 1955. Report of the Committee on Thresholds Limits. In Transactions of the Seventeenth Annual Meeting of the American Conference of Governmental Industrial Hygienists. April 23-26, 1955, edited by ACGIH. Buffalo, NY: ACGIH. p. 44-46.

ACGIH (American Conference of Governmental Industrial Hygienists). 1966. Air Sampling Instruments for Evaluation of Atmospheric Contaminants. Third Edition. Cincinnati, OH: American Conference for Governmental Industrial Hygienists.

ACGIH (American Conference of Governmental Industrial Hygienists). 1968. Transactions of the Thirtieth Annual Meeting of the American Conference of Governmental Industrial

Hygienists: St. Louis, Missouri, May 12-14, 1968. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
ACGIH (American Conference of Governmental Industrial Hygienists). 1971. TLVs Threshold Limit Values of Airborne Contaminants and Physical Agents with Intended Changes Adopted by ACGIH for 1971. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
ACGIH (American Conference of Governmental Industrial Hygienists). 1974a. Documentation of the Threshold Limit Values for Substances in Workroom Air, Third Edition 1971, Second Printing: Benzene - Skin. Cincinnati, OH: American Conference of Governmental Hygienists.
ACGIH (American Conference of Governmental Industrial Hygienists). 1974b. TLVs Threshold Limit Values for Chemical Substances in Workroom Air Adopted by ACGIH for 1974. Cincinnati, OH: American Conference of Governmental Hygienists.
ACGIH (American Conference of Governmental Industrial Hygienists). 1974c. TLVs threshold limit values for chemical substances in workroom air adopted by the American Conference of Governmental Industrial Hygienists for 1973. J Occup Med 16 (1):39-49.
ACGIH (American Conference of Governmental Industrial Hygienists). 1978. TLVs Threshold Limit Values for chemical substances and physical agents in the workroom environment with intended changes for 1978. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
ACGIH (American Conference of Governmental Industrial Hygienists). 1980. Asbestos. In American Conference of Governmental Industrial Hygienists, Documentation of the Threshold Limit Values: For Chemical Substances in the Workroom Environment. Fourth Edition, edited by ACGIH. Cincinnati, OH: American Conference of Governmental Industrial Hygienists. p. 27-30.
ACGIH (American Conference of Governmental Industrial Hygienists). 1980. Documentation of the Threshold Limit Values. Fourth Edition. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
ACGIH (American Conference of Governmental Industrial Hygienists). 1998. Supplements to the Sixth Edition. Documentation of Threshold Limit Values and Biological Exposure Indices. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
ACGIH (American Conference of Governmental Industrial Hygienists). 2001a. American Conference of Governmental Industrial Hygienists. Chronology of the ACGIH TLVs for asbestos. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
ACGIH (American Conference of Governmental Industrial Hygienists). 2001b. Chronology of the ACGIH TLVs for Asbestos. Compiled from Records of the ACGIH Chemical Substances

Threshold Limit Values Committee. Cincinnati, OH: American Conference for Governmental Industrial Hygienists.

ACGIH (American Conference of Governmental Industrial Hygienists). 2001c. Talc. In Documentation of the Threshold Limit Values For Chemical Substances in the Workroom Environment. Cincinnati, OH: American Conference of Governmental Industrial Hygienists (ACGIH). p. 1-7.

ACGIH (American Conference of Governmental Industrial Hygienists). 2010. Talc. In Respirable Particulate Matter (Containing No Asbestos and <1% Crystalline Silica). Cincinnati, OH: American Conference of Governmental Industrial Hygienists. p. 1-7.

Acheson, E. D., C. Bennett, M. J. Gardner, and P. D. Winter. 1981. Mesothelioma in a factory using amosite and chrysotile asbestos. Lancet 2 (8260-61):1403-6.

Acheson, E. D., M. J. Gardner, E. C. Pippard, and L. P. Grime. 1982. Mortality of two groups of women who manufactured gas masks from chrysotile and crocidolite asbestos: A 40-year follow-up. British Journal of Industrial Medicine 39 (4):344-8.

Addison, J., and E. E. McConnell. 2008. A review of carcinogenicity studies of asbestos and non-asbestos tremolite and other amphiboles. Regulatory Toxicology and Pharmacology 52 (1 Suppl):S187-99.

Agudo, A., C. A. Gonzalez, M. J. Bleda, J. Ramirez, S. Hernandez, F. Lopez, A. Calleja, R. Panades, D. Turuguet, A. Escolar, M. Beltran, and J. E. Gonzalez-Moya. 2000. Occupation and risk of malignant pleural mesothelioma: A case-control study in Spain. Am J Ind Med 37 (2):159-68.

AI (Asbestos Institute). 2000. Chrysotile Products: Regulation. Asbestos Institute. www.chrysotile.com/en/regulat/us.htm.

AIHA (American Industrial Hygiene Association). 2012. Lee Lecturer Asks Whether Elimination of Occupational Cancer Is within Reach. June 20, 2012. Accessed September 30, 2013: http://www.aiha.org/publications-and-resources/TheSynergist/AIHANews/Pages/Lee-Lecturer-Asks-Whether-Elimination-of-Occupational-Cancer-Is-within-Reach.aspx.

Air Hygiene Foundation. 1941. Digest of industrial hygiene. January. Pittsburgh, PA: Air Hygiene Foundation.

Alleman, J. E., and B. T. Mossman. 1997. Asbestos Revisited. Scientific American July:70-75.

Andersen, A., L. Barlow, A. Engeland, K. Kjaerheim, E. Lynge, and E. Pukkala. 1999. Work-related cancer in the Nordic countries. Scand J Work Environ Health 25 (Suppl 2):1-116.

Anderson, A. E., R. L. Gealer, R. C. McCune, and J. W. Sprys. 1973. Asbestos emissions from brake dynamometer tests. SAE Paper No. 730549. New York, NY: Society of Automotive Engineers Inc.

Anderson, A. M. 1900. Annual report on the work of her majesty's women inspectors, 1898. In Annual Report of the Chief Inspector of Factories and Workshops for the Year 1898. Part II -Reports, edited by HMSO. London: His Majesty's Stationery Office. p. 145-186.

Anderson, H. A. 1982. Family Contact Exposure. In Asbestos, Health and Society: Proceedings of World Symposium on Asbestos. Montreal, Quebec, Canada: Canadian Asbestos Information Center. p. 349-362.

Anderson, H. A., R. Lilis, S. M. Daum, A. S. Fischbein, and I. J. Selikoff. 1976. Household-contact asbestos neoplastic risk. Ann N Y Acad Sci 271:311-23.

Anderson, H., R. Lilis, S. Daum, A. Fischbein, and I. J. Selikoff. 1979. Household exposure to asbestos and risk of subsequent disease. In Dusts and disease, edited by R. Lemen and J. Dement. Chicago, IL: Pathotox Publishers. p. 145-156.

Anna, D. H. 2011. The Occupational Environment: Its Evaluation, Control and Management. Third Edition. 3rd edition. Fairfax, VA: American Industrial Hygiene Association.

Anonymous. 1904. Many Theaters Violating Law Shut Down by Mayor; Seventeen Which Have No Asbestos or Iron Curtain are Closed Till Properly Equipped. The Chicago Daily Tribune. January 2, 1904.

Anonymous. 1965. Results of Air Samples at Raybestos Manhattan Friction Plant, Charleston, South Carolina. PB81-239733. IWS-32-24a. May 1965. Cincinnati, OH: National Institute for Occupational Safety and Health.

Anonymous. 1967. Results of U.S.P.H.S. Survey at Raybestos Manhattan, Incorporated, Manheim, Pennsylvania. IWS-32.21a. PB81-229536. August 1967. Cincinnati, OH: National Institute for Occupational Safety and Health.

Anonymous. 1981. Asbestos 'snow' used by movie-makers for 20 years. Pittsburgh Post-Gazette, March 11, 1981.

ANSI (American National Standards Institute). 1991. Development and Objectives of the ANSI Z535 Series of Standards for Safety Signs and Colors: A Historical Perspective. Washington, D.C.: American National Standards Institute.

Antman, K. H., P. B. Schiff, and H. I. Pass. 1997. Benign and malignant mesothelioma. In Cancer: Principles & Practice of Oncology, edited by V. T. DeVita, S. S. Hellman and S. A. Rosenberg. Philadelphia: Lippincott-Raven Publishers. p. 1853-1878.

Arentzen, W. P. 1978. Twenty Navy Enlisted Rates at Greatest Risk of Asbestos Related Diseases. Enclosure 3 of Memo from Chief, Bureau of Medicine and Surgery Re: Asbestos Program, Dated 21 September 1978, in Reply to BUMED-552-JJB:bw6260.4. Washington, D.C. : Dept. of the Navy, Bureau of Medicine and Surgery.

Armstrong, T. W., F. W. Boelter, and J. O. Rasmuson. 2009. Exposure reconstruction. In Mathematical Models for Estimating Occupational Exposure to Chemicals, 2nd Edition, edited by C. Keil, C. Simmons and T. R. Anthony. Fairfax, VA: American Industrial Hygiene Association. p. 157-186.

Asbestos Research Council. 1973. The control of dust by exhaust ventilation when working with asbestos. Control and Safety Guide No. 7. London, England: Thomas Jenkins (Printers) Ltd.

Asbestos Textile Institute. 1961. Handbook of asbestos textiles, Second Edition. Philadelphia: Asbestos Textile Institute.

Asbestos Worker Journal. 1969-1972. Insulation Hygiene Progress Reports, Vols 1-4.

Ashcroft, T., and G. Heppleston. 1970. Mesothelioma and Asbestos on Tyneside: A Pathological and Social Study. In Pneumoconiosis: Proceedings of the International Conference, Johannesburg 1969. Cape Town: Oxford University Press. p. 177-179.

ASME. 1978. ASME B16.21 - 1978. Nonmetallic Flat Gaskets for Pipe Flanges. New York: American Society of Mechanical Engineers.

ASME. 1979. ASME B31.4 - 1979. Pipeline Transportation Systems for Liquids and Slurries. New York: American Society of Mechanical Engineers.

ASTM. 1952a. ASTM Designation: D 299-52T, Tentative Specifications and Methods of Test for Asbestos Yarns. Philadelphia, PA: American Society for Testing Materials.

ASTM. 1952b. ASTM Designation: D 375-52, Standard Specifications and Methods of Test for Asbestos Roving for Electrical Purposes. Philadelphia, PA: American Society for Testing Materials.

ASTM. 1952c. ASTM Designation: D 577-52, Standard Methods of Testing Woven Asbestos Cloth. Philadelphia, PA: American Society for Testing Materials.

ASTM. 1952d. ASTM Designation: D 628-52, Standard Methods of Testing Asbestos Tubular Sleeving. Philadelphia, PA: American Society for Testing Materials.

ASTM. 1956a. ASTM Designation: C 298-56, Standard Specifications for Cellular Asbestos Paper Thermal Insulation for Pipes. Philadelphia, PA: American Society for Testing Materials.

ASTM. 1956b. ASTM Designation: C 299-56, Standard Specifications for Laminated Asbestos Thermal Insulation for Pipes. Philadelphia, PA: American Society for Testing Materials.

ASTM. 1956c. ASTM Designation: D 250-56, Standard Specification for Asphalt-Saturated Asbestos Felts for Use in Waterproofing and in Constructing Built-Up Roofs. Philadelphia, PA: American Society for Testing Materials.

ASTM. 1964. ASTM F39-59. Standard Methods of Testing Compressed Asbestos Sheet Packing. Philadelphia, PA: American Society for Testing and Materials.

ASTM. 2002. ASTM D5755-02. Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Surface Loading. West Conshohocken, PA: ASTM International.

ASTM. 2014. ASTM D5755 - 09 (Reapproved 2014). Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Surface Loading. West Conshohocken, PA: ASTM International.

ATS (American Thoracic Society). 1990. Health effects of tremolite. This official statement of the American Thoracic Society was adopted by the ATS Board of Directors, June 1990. Am Rev Respir Dis 142 (6 Pt 1):1453-8.

ATSDR (Agency for Toxic Substances and Disease Registry). 2001. Toxicological Profile for Asbestos. Atlanta, GA: Agency for Toxic Substances and Disease Registry.

ATSDR (Agency for Toxic Substances and Disease Registry). 2002. Expert panel on health effects of asbestos and synthetic vitreous fibers (SVF): The influence of fiber length. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry.

Auribault, M. 1906. Sur l'hygiene et la securite des ouvriers dans les filatures et tissages d'amiante. Bull De L'Inspection Du Travail Quatorzieme Annee 14 (1-2):120-132.

Avens, H. J., J. R. Maskrey, A. L. Insley, K. M. Unice, R. C. D. Reid, and J. Sahmel. 2018. Characterization of airborne BTEX exposures during use of lawnmowers and trimmers. Archives of Environmental and Occupational Health ePub: DOI: 10.1080/19338244.2018.1426552.

Ayer, H. 1969. The Proposed ACGIH Mass Limits for Quartz: Review and Evaluation. AIHAJ 30 (2):117-125.

Ayer, H. E. 1964. Results of Sampling at American Asbestos Textile, Meredith, New Hampshire. IWS-32.15a. July 1964. Cincinnati, OH: Environmental Investigation Branch Division of Field Studies and Clinical Investigations, National Institute for Occupational Safety and Health.

Ayer, H. E., J. R. Lynch, and J. H. Fanney. 1965. A comparison of impinger and membrane filter techniques for evaluating air samples in asbestos plants. Annals of the New York Academy of Sciences 132 (1):274-87.

Aylott, R. I., G. A. Byrne, J. D. Middleton, and M. E. Roberts. 1979. Normal use levels of respirable cosmetic talc: Preliminary study. International Journal of Cosmetic Science 1 (3):177-86.

Baetjer, A. M. 1984. The early days of industrial hygiene- Their contribution to current problems. In Threshold Limit Values: Discussion and Thirty-Five Year Index with

Recommendations . Annals of the American Conference of Industrial Hygienists: Volume 9, edited by M. E. LaNier. Cincinnati, OH: American Conference of Governmental Industrial Hygienists. p. 15-20.

Baker, E. L., T. Dagg, and R. E. Greene. 1985. Respiratory illness in the construction trades. I. The significance of asbestos-associated pleural disease among sheet metal workers. J Occup Med 27 (7):483-9.

Balzer, J. L., and W. C. Cooper. 1968. The work environment of insulating workers. American Industrial Hygiene Association Journal 29 (3):222-7.

Balzer, J., D. P. Fowler, and W. Clark Cooper. 1972. Dust-producing potential of construction materials. In Safety and Health in Shipbuilding and Ship Repairing. Proceedings of a symposium organized by the government of Finland, the Institute of Occupational Health, Helsinki, the Finnish Accident Prevention Association and Organisations of Employers and workers in the Finnish shipbuilding industry, in collaboration with the International Labour Office, edited by G. International Labour Office. Helsinki, Finland.

Bang, K. M., J. M. Mazurek, G. Syamlal, and J. M. Wood. 2008. Asbestosis mortality surveillance in the United States, 1970-2004. Int J Occup Environ Health 14 (3):161-9.

Barlow, C. A., J. Sahmel, D. J. Paustenbach, and J. L. Henshaw. 2017. History of knowledge and evolution of occupational health and regulatory aspects of asbestos exposure science: 1900-1975. Critical Reviews in Toxicology 47 (4):286-316.Barnes, R. 1976. Asbestos spraying, an occupational and environmental hazard. Med J Aust 2 (16):599-602.

Barnett, G. P. 1949. Annual report of the chief inspector of factories for the year 1947. January 1949, London. His Majesty's Stationery Office.

Bartrip, P. 1998. Too little, too late? The home office and the asbestos industry regulations, 1931. Med Hist 42 (4):421-38.

Baxter, D., R. Ziskind, and R. Shokes. 1983a. Final Report: Ambient Asbestos Concentrations in California, Field Number and Mass Concentration Summaries, Volume II. December 1, 1983. Sacramento, CA: California Air Resources Board.

Baxter, D., R. Ziskind, and R. Shokes. 1983b. Final Report: Ambient Asbestos Concentrations in California, Volume I. Sacramento, CA: California Air Resources Board.

Bayer, S. G., R. D. Zumwalde, and T. A. Brown. 1969. Equipment and Procedure for Mounting Millipore Filters and Counting Asbestos Fibers by Phase Contrast Microscopy. Cincinnati,OH: Bureau of Occupational Health, U.S. Dept. of Health, Education and Welfare.

Beckett, R. R. 1976. Asbestos exposure control at Puget Sound Naval Shipyard. Environ Res 11 (2):248-60.

Bégin, R., J. J. Gauthier, M. Desmeules, and G. Ostiguy. 1992. Work-related mesothelioma in Quebec, 1967-1990. Am J Ind Med 22 (4):531-42.

Berg, R. B. 1997. Montana's changing industrial minerals industry: Wyoming State Geological Survey Public Information Circular 38. p. 167-175.

Berger, H., and R. E. Oesper. 1963. Fibers: Classification, standardization, disintegration. In Asbestos Fundamentals - origin, properties, mining, processing, utilization, edited by H. Berger and R. E. Oesper. New York: Chemical Publishing Company, Inc. p. 61-78.

Berman, D. W. 2010. Comparing milled fiber, Quebec ore, and textile factory dust: has another piece of the asbestos puzzle fallen into place? Crit Rev Toxicol 40 (2):151-88.

Berman, D. W. 2011. Apples to apples: the origin and magnitude of differences in asbestos cancer risk estimates derived using varying protocols. Risk Anal 31 (8):1308-26.

Berman, D. W., and K. S. Crump. 2001. Assessing asbestos-related risk: New thinking/new protocol. Paper read at 2001 Asbestos Health Effects Conference, May 24-25, 2001, at Oakland, Ca.

Berman, D. W., and K. S. Crump. 2003. Final Draft: Technical Support Document for a Protocol to Assess Asbestos-Related Risk. EPA# 9345.4-06. October 2003. Washington, D.C.: U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response.

Berman, D. W., and K. S. Crump. 2008a. A meta-analysis of asbestos-related cancer risk that addresses fiber size and mineral type. Critical Reviews in Toxicology 38 Suppl 1:49-73.

Berman, D. W., and K. S. Crump. 2008b. Update of potency factors for asbestos-related lung cancer and mesothelioma. Critical Reviews in Toxicology 38 Suppl 1:1-47.

Berman, D. W., K. S. Crump, E. J. Chatfield, J. M. Davis, and A. D. Jones. 1995. The sizes, shapes, and mineralogy of asbestos structures that induce lung tumors or mesothelioma in AF/HAN rats following inhalation. Risk Analysis 15 (2):181-95. Erratum in: Risk Anal 15(4):541.

Bernstein, D. M. T., B.; Rogers, R.A.; Sepulveda, R.; Kunzendorf, P.; Phillips, J.I.; Ernst, H. . 2018. Evaluation of the dose-response and fate in the lung and pleura of chrysotile-containing brake dust compared to chrysotile or crocidolite asbestos in a 28-day quantitative inhalation toxicology study. Toxicology and Applied Pharmacology 351:74-92.

Bernstein, D. M., and J. A. Hoskins. 2006. The health effects of chrysotile: Current perspective based upon recent data. Regulatory Toxicology and Pharmacology 45 (3):252-64.

Bernstein, D. M., R. A. Rogers, R. Sepulveda, P. Kunzendorf, B. Bellmann, H. Ernst, O. Creutzenberg, and J. I. Phillips. 2015. Evaluation of the fate and pathological response in the lung and pleura of brake dust alone and in combination with added chrysotile compared to crocidolite asbestos following short-term inhalation exposure. Toxicology and Applied Pharmacology 283 (1):20-34.

Bernstein, D. M., R. Rogers, R. Sepulveda, P. Kunzendorf, B. Bellmann, H. Ernst, and J. I. Phillips. 2014. Evaluation of the deposition, translocation and pathological response of brake dust with and without added chrysotile in comparison to crocidolite asbestos following short-term inhalation: Interim results. Toxicology and Applied Pharmacology 276 (1):28-46.

Berry, G., and M. L. Newhouse. 1983. Mortality of workers manufacturing friction materials using asbestos. Br J Ind Med 40 (1):1-7.

Betsinger, G., L. M. Brosseau, and J. Golden. 2000. Occupational health and safety in household hazardous waste management facilities. AIHAJ 61 (4):575-83.

Beyer, D. S. 1933. The Mechanical Control of Occupational Diseases. National Safety News 28 (2):21-22, 54.

Bianchi, C., A. Brollo, and C. Zuch. 1993. Asbestos-related familial mesothelioma. Eur J Cancer Prev 2 (3):247-50.

Bittersohl, G., and H. Ose. 1971. [Epidemiology of pleural mesothelioma]. Z Gesamte Hyg 17 (11):861-4.

Blake, C. L., D. R. Van Orden, M. Banasik, and R. D. Harbison. 2003. Airborne asbestos concentration from brake changing does not exceed permissible exposure limit. Regul Toxicol Pharmacol 38 (1):58-70.

Blake, C. L., G. S. Dotson, and R. D. Harbison. 2006. Assessment of airborne asbestos exposure during the servicing and handling of automobile asbestos-containing gaskets. Regul Toxicol Pharmacol 45 (2):214-22.

Blake, C. L., G. S. Dotson, and R. D. Harbison. 2008. Evaluation of asbestos exposure within the automotive repair industry: a study involving removal of asbestos-containing body sealants and drive clutch replacement. Regul Toxicol Pharmacol 52 (3):324-31.

Bloomfield, J. J., and J. M. Dallavalle. 1935. The Determination and Control of Industrial Dust. Public Health Bulletin No. 217. Washington, D.C: U.S. Treasury Department, Public Health Service.

Blount, A. M. 1991. Amphibole content of cosmetic and pharmaceutical talcs. Environ Health Perspect 94:225-30.

BLS (Bureau of Labor Standards). 1971. Title 29 -- Labor; Chapter XIII -- Part 1518 - Safety and health regulations for construction: Standard for exposure to asbestos dust. Fed Reg 36: 23207-23208. December 7, 1971.

Boelter, F. W. 2003. Letter to the editor, author's reply: Airborne fiber exposure assessment of dry asbestos-containing gaskets and packings found in intact industrial and maritime fittings. American Industrial Hygiene Association Journal 64 (5):595-597.

Boelter, F. W., G. N. Crawford, and D. M. Podraza. 2002. Airborne fiber exposure assessment of dry asbestos-containing gaskets and packings found in intact industrial and maritime fittings. American Industrial Hygiene Association Journal 63 (6):732-40.

Boelter, F. W., J. W. Spencer, and C. E. Simmons. 2007. Heavy equipment maintenance exposure assessment: using a time-activity model to estimate surrogate values for replacement of missing data. J Occup Environ Hyg 4 (7):525-37.

Boelter, F., and J. Spencer. 2003. Caterpillar Equipment Study: An Evaluation of Airborne Asbestos Exposure During Maintenance and Repair of Caterpillar Equipment. October 29, 2003.

Boelter, F., C. Simmons, and P. Hewett. 2011. Exposure data from multi-application, multi-industry maintenance of surfaces and joints sealed with asbestos-containing gaskets and packing. Journal of Occupational and Environmental Hygiene 8 (4):194-209.

Boeniger, M., J. Sahmel, J. Walton, and R. Roy. 2015. Appendix II: Dermal exposure monitoring and estimation of dermal exposures. In A Strategy for Assessing and Managing Occupational Exposures. 4th Edition, edited by S. D. Jahn, W. H. Bullock and J. S. Ignacio. Fairfax, VA: AIHA. p. 381-399.

Bohlig, H., and E. Hain. 1973. Cancer in relation to environmental exposure. In Biological Effects of Asbestos; Proceedings of a Working Conference. IARC Scientific Publications; No. 8, edited by P. Bogovski, V. Timbrell, J. C. Gilson and J. C. Wagner. Lyon: International Agency for Research on Cancer. p. 217-221.

Boillat, M. A., and M. Lob. 1973. [Risk of asbestosis in workers employed in replacing automobile brake linings]. Schweiz Med Wochenschr 103 (39):1354-9.

Bonser, G. M., J. S. Faulds, and M. J. Stewart. 1955. Occupational cancer of the urinary bladder in dyestuffs operatives and of the lung in asbestos textile workers and iron-ore miners. Am J Clin Pathol 25 (2):126-34.

Bouchardy, C., G. Schuler, C. Minder, P. Hotz, A. Bousquet, F. Levi, T. Fisch, J. Torhorst, and L. Raymond. 2002. Cancer risk by occupation and socioeconomic group among men--a study by the Association of Swiss Cancer Registries. Scand J Work Environ Health 28 Suppl 1:1-88.

Bourdes, V., P. Boffetta, and P. Pisani. 2000. Environmental exposure to asbestos and risk of pleural mesothelioma: review and meta-analysis. Eur J Epidemiol 16 (5):411-7.

Bowles, O. 1959. Asbestos: A Materials Survey. Bureau of Mines Information Circular 7880. Washington, D.C.: US GPO.

Brachmann, D. 1940. Asbestose bei bremsbandschleifern und bohrern [Asbestosis in brake-belt grinders and drillers]. Berlin: Otto Stollberg. p. 172-174.

Bragg, G. M., L. van Zuiden, and C. E. Hermance. 1974. The free fall of cylinders at intermediate Reynold's numbers. Atmospheric Environment 8:755-764.

Braun, D. C., and T. D. Truan. 1958. An epidemiological study of lung cancer in asbestos miners. AMA Arch Ind Health 17 (6):634-53.

Breslow, L., L. Hoaglin, G. Rasmussen, and H. K. Abrams. 1954. Occupations and cigarette smoking as factors in lung cancer. Am J Public Health Nations Health 44 (2):171-81.

Brown, E. 1941. Industrial hygiene and the navy in national defense. War Medicine 1:3-14.

Brown, G. A. 1982. Bethlehem Steel Inter-Office Correspondence from G.A. Brown to W.H. Shure and R.C. Squier, RE: Asbestos Survey: #2 Bethcon Line, Cold Sheet Mill. April 6, 1982.

Brown, M. C. 1966. Asbestos safety reaffirmed. Chemical Week October 8:7-7.

Brown, R. 1985. Memo from QRAC (Quantitative Risk Assessment Committee) to W. Gary Flamm, Ph.D. (Director, Office of Toxicological Sciences - Food and Drug Administration), RE: Asbestos in Talc. Dated June 6, 1985.

Brown, V. 1948. Memorandum from Vandiver Brown to Mr. Ernest Muehleck, dated April 30, 1948.

Browne, C. 2003. Salamander's Wool: The Historical Evidence for Textiles Woven with Asbestos Fibre. Textile History 34 (I):64-73.

Brune, D., and H. Beltesbrekke. 1981. Levels of methylmethacrylate, formaldehyde, and asbestos in dental workroom air. Scandinavian Journal of Dental Research 89 (1):113-6.

Burdett, G., and P. R. Stacey. 2001. Improved Methods for Clearance Testing and Visual Assessment of Asbestos Removal Operations. HSL/2001/11. Sheffield: Health and Safety Laboratory.

Bureau of Mines. 1952. 1950 Materials Survey Asbestos, February 1952: Prepared for the Materials Office, National Security Resources Board by the United States Department of the Interior, Bureau of Mines.

Burnett, C., J. Mauer, H. M. Rosenberg, and M. Dosemeci. 1997. Mortality by Occupation, Industry and Cause of Death: 24 Reporting States (1984-1988). DHHS (NIOSH) Publication No. 97-114. June 1997. Cincinnati, OH: U.S. Dept. of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

Burns, P. B., and G. M. Swanson. 1991. The Occupational Cancer Incidence Surveillance Study (OCISS): risk of lung cancer by usual occupation and industry in the Detroit metropolitan area. Am J Ind Med 19 (5):655-71.

Burns, A. M., C. A. Barlow, A. M. Banducci, K. M. Unice, and J. Sahmel. 2019. Potential Airborne Asbestos Exposure and Risk Associated with the Historical Use of Cosmetic Talcum Powder Products. Risk Anal doi: 10.1111/risa.13312.

Cal/EPA Air Resources Board. 2015. Asbestos Air Monitoring- Oakridge High School, El Dorado Hills. Accessed December 7, 2016: https://www.arb.ca.gov/toxics/asbestos/orhs.htm.

Campbell, W. J., R. L. Blake, L. L. Brown, E. E. Cather, and J. J. Sjoberg. 1977. Selected Silicate Minerals and Their Asbestiform Varieties: Mineralogical Definitions and Identification-Characterization. Information Circular 8751. Washington, D.C.: U.S. Department of the Interior, U.S. Bureau of Mines Report of Investigations.

Camus, M., J. Siemiatycki, B. W. Case, M. Desy, L. Richardson, and S. Campbell. 2002. Risk of mesothelioma among women living near chrysotile mines versus USEPA asbestos risk model: Preliminary findings. Ann Occup Hyg 46 (Suppl 1):95-98.

Canepa, G. 1949. L'asbestosi nei lavoratori portuali [Asbestosis in port workers]. J Leg Med Insur XII of 2nd series (3-4):188-205.

Caravanos, J. 1991. Quantitative Industrial Hygiene: A Formula Workbook. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

Carroll, W. G. 1962. The manufacture of brake linings. British Plastics 35 (8):414-417.

Cartier, P. 1952. Re: Cases of carcinoma of the lungs detected among 4000 asbestos workers 1940-1950. Arch Ind Hyg 5 (3):262-263.

Cartier, P. 1955. Some clinical observations of asbestosis in mine and mill workers. AMA Arch Ind Health 11 (3):204-7.

Case, B. W. 2008. From Cotton-Stone to the New York Conference: Asbestos-Related Diseases 1878-1965. In Asbestos and Its Diseases, edited by J. E. Craighead and A. R. Gibbs. New York: Oxford University Press. p. 3-22.

Case, B. W., M. Camus, L. Richardson, M.-E. Parent, M. Desy, and J. Siemiatycki. 2002. Preliminary findings for pleural mesothelioma among women in the Quebec chrysotile mining regions. Ann Occup Hyg 46 (Supp 1):128-131.

Castleman, B. I., and G. E. Ziem. 1988. Corporate influence on threshold limit values. Am J Ind Med 13 (5):531-59.

Castrop, V. J. 1948. Recognition and control of fume and dust exposure Nat Safety News 57:20-21, 52, 73-80.

Cely-Garcia, M. F., C. A. Torres-Duque, M. Duran, P. Parada, O. L. Sarmiento, P. N. Breysse, and J. P. Ramos-Bonilla. 2015. Personal exposure to asbestos and respiratory health of heavy vehicle brake mechanics. Journal of Exposure Science and Environmental Epidemiology 25 (1):26-36.

Cely-Garcia, M. F., M. Sanchez, P. N. Breysse, and J. P. Ramos-Bonilla. 2012. Personal Exposures to Asbestos Fibers During Brake Maintenance of Passenger Vehicles. Ann Occup Hyg 56 (9):985-99.

Cha, S., P. Carter, and R. L. Bradow. 1983. Simulation of Automobile Brake Wear Dynamics and Estimation of Emissions. SAE Technical Paper Series 831036. Warrendale, PA: Society of Automotive Engineers, Inc.

Champion, P. 1971. Two cases of malignant mesothelioma after exposure to asbestos. Am Rev Respir Dis 103 (6):821-6.

Cheng, R. T., and H. J. McDermott. 1991. Exposure to asbestos from asbestos gaskets. Applied Occupational and Environmental Hygiene 6 (7):588-591.

Cheng, V. K., and F. J. O'Kelly. 1986. Asbestos exposure in the motor vehicle repair and servicing industries in Hong Kong. J Soc Occup Med 36:104-106.

Cherowbrier, E. 1969. Preventing Asbestos Inhalation. Naval Ships Systems Command Technical News May:10-11.

Chrysotile Institute. 1981. Canadian Chrysotile Asbestos Classification. January 9, 1981.

Churg, A. 1988. Chrysotile, tremolite, and malignant mesothelioma in man. Chest 93 (3):621-8.

Clark, W. I., and P. Drinker. 1935. Industrial Medicine. New York: National Medical Book Company, Inc.

Cocco, P., and M. Dosemeci. 1999. Peritoneal cancer and occupational exposure to asbestos: results from the application of a job-exposure matrix. Am J Ind Med 35 (1):9-14.

Coggiola, M., D. Bosio, E. Pira, P. G. Piolatto, C. La Vecchia, E. Negri, M. Michelazzi, and A. Bacaloni. 2003. An update of a mortality study of talc miners and millers in Italy. Am J Ind Med 44 (1):63-9.

Coggon, D., H. Inskip, P. Winter, and B. Pannett. 1995. Differences in occupational mortality from pleural cancer, peritoneal cancer, and asbestosis. Occup Environ Med 52 (11):775-7.

Cohen, H. J., and D. R. Van Orden. 2008. Asbestos exposures of mechanics performing clutch service on motor vehicles. J Occup Environ Hyg 5 (3):148-56.

Coles, G. V. 1993. Re: "TLVs for asbestos". Am J Ind Med 23 (6):955-7.

Compton, S. P., and J. R. Millette. 2010. Report of Results: MVA8473. Fiber Release During Activities Involving a Caterpillar Brake Band. July 30, 2010. Duluth, GA: MVA Scientific Consultants.

Compton, S. P., and J. R. Millette. 2011. Report of Results: MVA8997, Analysis of a Kent Micronite Cigarette, October 12, 2011. Duluth, GA: MVA Scientific Consultants.

CONSAD Research Corporation. 1990. Economic analysis of the proposed revisions to the OSHA asbestos standards for construction and general industry. Pittsburgh, PA: CONSAD Research Corporation (unpublished)

Consumer Product Safety Commission (CPSC). 1988. Consumer Product Safety Commission. Briefing package of the CPSC Office of the Secretary on a petition to ban play sand with non-asbestiform tremolite: U.S. Product Safety Commission.

Cook, W. A. 1992. TLVs for asbestos. Am J Ind Med 21 (5):765-6.

Cooke, W. E. 1924. Fibrosis of the lungs due to the inhalation of asbestos dust. British Medical Journal 2 (3317):147.

Cooke, W. E. 1927. Pulmonary asbestosis. British Medical Journal 2:1024-1025.

Cooper, T. C., J. W. Sheehy, D. M. O'Brien, J. D. McGlothlin, and W. Todd. 1987. In-Depth Survey Report: Evaluation of Brake Drum Service Controls at United States Postal Service Vehicle Maintenance Facility, Louisville, Kentucky. ECTB 152-11b. December 1987. Cincinnati, OH: National Institute for Occupational Safety and Health, Division of Physical Sciences and Engineering, Engineering Control Technology Branch.

Cooper, T. C., J. W. Sheehy, D. M. O'Brien, J. D. McGlothlin, and W. Todd. 1988. In-Depth Survey Report: Evaluation of Brake Drum Service Controls at Cincinnati Gas and Electric Garages, Cincinnati, Evanston, and Monroe, Ohio and Covington, Kentucky. Report No. ECTB 152-22b. January 1988. Cincinnati, OH: National Institute for Occupational Safety and Health, Division of Physical Sciences and Engineering, Engineering Control Technology Branch.

Cooper, W. C. 1979. The Forum . . . Comment on the letter from Mr. Krafcisin. American Industrial Hygiene Association Journal 40:A56-57.

Cooper, W. C., and J. L. Balzer. 1968. Evaluation and control of asbestos exposure in the insulating trade. In Second International Conference on the Biological Effects of Asbestos, April 21-24, 1968. Dresden, Germany. p. 151-160.

COPC. 2003. World Trade Center Indoor Environment Assessment: Selecting Contaminants of Potential Concern and Setting Health-Based Benchmarks. May 2003. Accessed December 4, 2015: http://archive.epa.gov/wtc/web/pdf/contaminants_of_concern_benchmark_study.pdf.

Corn, J. K. 1989. Protecting the Health of Workers: The American Conference of Governmental Industrial Hygienists 1938-1988. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

Corn, J. K., and J. Starr. 1987. Historical perspective on asbestos: policies and protective measures in World War II shipbuilding. Am J Ind Med 11 (3):359-73.

Corn, M. 1961a. The adhesion of solid particles to solid surfaces. I. A review. J Air Pollut Control Assoc 11:523–528.

Corn, M. 1961b. The adhesion of solid particles to solid surfaces. II J Air Pollut Control Assoc 11:566–575.

Corn, M. 1986. Asbestos and disease: an industrial hygienist's perspective. Am Ind Hyg Assoc J 47 (9):515-23.

Corn, M., and F. Stein. 1966. Mechanism of dust redispersion. In Surface Contamination, edited by B. R. Fish. Gatlinburg, TN: Pergamon Press. p. 45-54.

Corn, M., and J. K. Corn. 1993. Re: Historical reasons for attitudes and opinions regarding asbestos and cancer, 1934-1965. Am J Ind Med 23 (3):513-5.

Courtice, M. N., D. W. Berman, E. Yano, N. Kohyama, and X. Wang. 2016. Size- and type-specific exposure assessment of an asbestos products factory in China. J Expo Sci Environ Epidemiol 26 (1):63-9.

Courtice, M. N., X. Wang, S. Lin, I. T. Yu, D. W. Berman, and E. Yano. 2016. Exposure-response estimate for lung cancer and asbestosis in a predominantly chrysotile-exposed Chinese factory cohort. American Journal of Industrial Medicine 59 (5):369-78.

Craighead, J. E. 2008. U.S. Governmental Regulatory Approaches and Actions. In Asbestos and Its Diseases, edited by J. E. Craighead and A. R. Gibbs. New York: Oxford University Press. p. 317-325.

Craighead, J. E., and A. R. Gibbs. 2008. Diseases Associated with Asbestos Industrial Products and Environmental Exposure. In Asbestos and Its Diseases: Oxford University Press. p. 39-93.

Cralley, L. V., L. J. Cralley, G. D. Clayton, and J. A. Jurgiel. 1972. Asbestos. In Industrial Environmental Health: The Worker and the Community, edited by L. V. Cralley, L. J. Cralley, G. D. Clayton and J. A. Jurgiel. New York: Academic Press. p. 4-9.

Crump, K. S., and D. B. Farrar. 1989. Statistical analysis of data on airborne asbestos levels collected in an EPA survey of public buildings. Regul Toxicol Pharmacol 10 (1):51-62.

CTFA (The Cosmetic, Toiletry and Fragrance Association),. 1976. CFTA Method J 4-1. Asbestiform Amphibole Minerals in Cosmetic Talc. Part I: X-Ray Diffraction Method, Part II: Optical Microscopy and Dispersion-Staining Method. Washington, D.C.: The Cosmetic, Toiletry and Fragrance Association.

Davis, J. M. 1981. The biological effects of mineral fibers. Ann Occup Hyg 24 (2):227-234.

Davis, J. M. 1989. Mineral fibre carcinogenesis: experimental data relating to the importance of fibre type, size, deposition, dissolution and migration. IARC Sci Publ (90):33-45.

Davis, J. M., J. Addison, C. McIntosh, B. G. Miller, and K. Niven. 1991. Variations in the carcinogenicity of tremolite dust samples of differing morphology. Ann N Y Acad Sci 643:473-90.

Davis, J. M., J. Addison, R. E. Bolton, K. Donaldson, A. D. Jones, and T. Smith. 1986. The pathogenicity of long versus short fibre samples of amosite asbestos administered to rats by inhalation and intraperitoneal injection. Br J Exp Pathol 67 (3):415-30.

Davis, J. M., S. T. Beckett, R. E. Bolton, P. Collings, and A. P. Middleton. 1978. Mass and number of fibres in the pathogenesis of asbestos-related lung disease in rats. Br J Cancer 37 (5):673-88.

Deane, L. 1898. Annual Report of the Chief Inspector of Factories and Workshops for the Year 1898. Part II -Report. London: His Majesty's Stationery Office.

Dement, J. M. 1972. Cincinnati Municipal Garage, Automobile Brake Servicing Operation. Report #32.11. March 16, 1972. In U. S. Public Health Survey. Cincinnati, OH.

Dement, J. M., D. Loomis, D. Richardson, S. Wolf, and D. Myers. 2008. Estimates of Historical Exposures by Phase Contrast and Transmission Electron Microscopy in North Carolina USA Asbestos Textile Plants. Occup Environ Med 66 (9):574-583.

Dement, J. M., P. J. Shuler, and R. D. Zumwalde. 1972. Preliminary Report: Fiber Exposure During Use of Baby Powders. July 1972. Cincinnati, OH: Environmental Investigations Branch, Division of Field Studies and Clinical Investigations, National Institute for Occupational Safety and Health.

Dement, J. M., R. D. Zumwalde, J. F. Gamble, W. Fellner, M. J. DeMeo, D. P. Brown, and J. K. Waoner. 1980. Occupational Exposure to Talc Containing Asbestos: Morbidity, Mortality, and Environmental Studies of Miners and Millers. I. Environmental Study II. Cross Sectional Morbidity Study III. Retrospective Cohort Study of Mortality. DHEW (NIOSH) Publication No. 80-115. February 1980. Washington, D.C.: U.S. Dept. of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health.

Dement, J. M., R. L. Harris Jr., M. J. Symons, and C. M. Shy. 1983a. Exposures and mortality among chrysotile asbestos workers. Part I: exposure estimates. Am J Ind Med 4 (3):399-419.

Dement, J. M., R. L. Harris Jr., M. J. Symons, and C. M. Shy. 1983b. Exposures and mortality among chrysotile asbestos workers. Part II: mortality. Am J Ind Med 4 (3):421-33.

Dement, J. M., R. L. Harris, Jr., M. J. Symons, and C. Shy. 1982. Estimates of dose-response for respiratory cancer among chrysotile asbestos textile workers. Annals of Occupational Hygiene 26 (1-4):869-887.

Department of Labor. 1951. For Contractors Performing Federal Supply Contracts Under the Walsh-Healey Public Contracts Act. Contracts Division. Washington, D.C.: U.S. Department of Labor, Wage and Hour Public Contracts Division.

Department of Labor. 1952. Safety and Health Standards for Contractors Performing Federal Supply Contracts Under the Walsh-Healey Public Contracts Act. Washington, D.C.: U.S. Department of Labor, Wage and Hour Public Contracts Division.

Department of Labor. 1960. Part 50-204: Safety and Health Standards for Federal Supply Contracts. Fed. Reg. 25(251):13809-13825. December 28, 1960.

Department of Labor. 1966. General Safety and Health Standards for Federal Supply Contracts Under the Walsh-Healey Public Contracts Act. Washington, D.C.: U.S. Department of Labor, Bureau of Labor Standards.

Department of Labor. 1969a. Safety and Health Standards for Federal Supply Contracts. Fed. Reg. 34(12): 788-796. January 17, 1969.

Department of Labor. 1969b. Safety and Health Standards for Federal Supply Contracts. Fed. Reg. 34(96): 7946-7954. May 20, 1969.

Division of Public Contracts. 1960. Title 41 -- Public contracts, Chapter 50, Part 50-204--Safety and health standards for federal supply contracts. Fed. Reg. 25:13809-13825 Department of Labor (DOL). December 28, 1960.

Dodson, R. F., M. A. Atkinson, and J. L. Levin. 2003. Asbestos fiber length as related to potential pathogenicity: a critical review. Am J Ind Med 44 (3):291-7.

DOL (Department of Labor). 1952. Safety and health standards for contractors performing federal supply contracts under the Walsh-Healey Public Contracts Act. Edited by W. a. H. P. C. D. U.S. Department of Labor. Washington, D.C.: United States Government Printing Office.

DOL (Department of Labor). 1960. Title 29 - Subtitle A - Office of the Secretary of Labor. Part 8 - Safety and Health Regulations for Ship Repairing. Fed Reg 25 (36): 1543-1563. February 20, 1960.

Doll, R. 1953. Bronchial carcinoma: Incidence and ætiology. Br Med J:521-527, 585-590.

Doll, R. 1955. Mortality from lung cancer in asbestos workers. British Journal of Industrial Medicine 12 (2):81-6.

Doll, R., and J. Peto. 1985. Asbestos: effects on health of exposure to asbestos. Prepared for Health and Safety Commission. London: Her Majesty's Stationary Office.

Donnelly, J. 1936. Pulmonary asbestosis: incidence and prognosis. J Ind Hyg Toxicol 18 (41):222-228.

Donovan, E. P., B. L. Donovan, J. Sahmel, P. K. Scott, and D. J. Paustenbach. 2011. Evaluation of bystander exposures to asbestos in occupational settings: A review of the literature and application of a simple eddy diffusion model. Critical Reviews in Toxicology 41 (1):50-72.

Donovan, E. P., B. L. Donovan, M. A. McKinley, D. M. Cowan, and D. J. Paustenbach. 2012b. Evaluation of take home (para-occupational) exposure to asbestos and disease: a review of the literature. Crit Rev Toxicol 42 (9):703-31.

Donovan, E., J. Sahmel, P. Scott, and D. Paustenbach. 2012a. Response to a letter to the Editor by Dr. David Egilman and Mr. John Schilling regarding the article by Donovan et al. (2011). Crit Rev Toxicol 42 (2):173-183.

Douillet, P. 1983. Memo from Philippe Douillet to Hon. Mark Novitch (Acting Commissioner, Food and Drug Administration) RE: Petition for Labeling of Warning of the Hazardous Effects Produced by Asbestos in Cosmetic Talc. Dated November 8, 1983.

Dreessen, W. C. 1933. Effects of certain silicate dusts on the lungs. Journal of Industrial Hygiene 15:66-78.

Dreessen, W. C., and J. M. Dalla Valle. 1935. The effects of exposure to dust in two Georgia talc mills and mines. Public Health Rep 50:131-143.

Dreessen, W. C., J. M. Dallavalle, T. I. Edwards, J. W. Miller, and R. R. Sayers. 1938. A Study of Asbestosis in the Asbestos Textile Industry, Public Health Bulletin No. 241. August 1938. Washington, D.C.: U.S. Treasury Department, Public Health Service, National Institute of Health, Division of Industrial Hygiene.

Drever, F. 1995. Occupational health: Decennial supplement: The Registrar General's decennial supplement for England and Wales. In Series DS no. 10. London: Office of Population Censuses and Surveys, Health and Safety Executive, HMSO. p. 23, 135, 289, 302.

Drinker, P. 1944. Letter to Captain Ingram, Bureau of Ships, Navy Department. Washington, D.C., January 8, 1944.

Drinker, P., and T. Hatch. 1954. Industrial Dust, Hygienic Significance, Measurement, and Control. Second edition. New York, NY: McGraw-Hill.

Drivas, P. J., P. A. Valberg, B. L. Murphy, and R. Wilson. 1996. Modeling Indoor Air Exposure from Short-Term Point Source Releases. Indoor Air 6 (4):271-277.

Drucker, E., D. Nagin, D. Michaels, M. Lacher, and S. Zoloth. 1987. Exposure of sheet-metal workers to asbestos during the construction and renovation of commercial buildings in New York City. A case study in social medicine. Ann N Y Acad Sci 502:230-44.

Dupre, J. S., J. F. Mustard, and R. J. Uffen. 1984. Report of the Royal Commission on Matters of Health and Safety Arising from the Use of Asbestos in Ontario. Toronto, Canada: Queen’s Printer for Ontario.

Eckardt, R. E., and P. Drinker. 1954. Experimental lung cancer. AMA Arch Ind Hyg Occup Med 9 (6):449-50.

Edge, J. R., and S. L. Choudhury. 1978. Malignant mesothelioma of the pleura in Barrow-in-Furness. Thorax 33 (1):26-30.

Edwards, G. H., and J. R. Lynch. 1968. The method used by the U.S. Public Health Service for enumeration of asbestos dust on membrane filters. Ann Occup Hyg 11 (1):1-6.

Egilman, D. S., and A. A. Reinert. 1995. The origin and development of the asbestos Threshold Limit Value: scientific indifference and corporate influence. International journal of health services : planning, administration, evaluation 25 (4):667-96.

Eiermann, H. J. 1976. Internal Memo from Heinz J. Eiermann (U.S. FDA - Director, Division of Cosmetics Technology) to Robert M. Schaffner (U.S. FDA - Associate Director for Technology), RE: Asbestos in Talc. Dated March 18, 1976.

Elliehausen, H.-J., R. Paur, K. Rodelsperger, and H.-J. Woitowitz. 1985. Zum Risiko von Asbestinhalationsfolgen bei Draft-fahrzeugmechanikern in Bremsendiensten [About the risk of asbestos inhalation in automobile mechanics in the brake service]. Arbeitsmed Sozialmed Prevenitmed 20:256-261.

Engholm, G., and A. Englund. 2005. Asbestos hazard in the Swedish construction industry--recent trends in mesothelioma incidence. Scand J Work Environ Health 31 Suppl 2:27-30.

Enterline, P. E. 1991. Changing attitudes and opinions regarding asbestos and cancer 1934-1965. Am J Ind Med 20 (5):685-700.

Enterline, P. E., and V. Henderson. 1973. Type of asbestos and respiratory cancer in the asbestos industry. Arch Environ Health 27 (5):312-7.

Enterline, P. E., N. Sussman, and G. M. Marsh. 1978. Asbestos and Cancer: The First Thirty Years.

EPA. 1989. 40 CFR Part 763: Asbestos: Manufacture, Importation, Processing, and Distribution in Commerce Prohibitions. Fed. Reg. 54: 29460-29513.

EPA. 2008. Framework for Investigating Asbestos-Contaminated Superfund Sites. OSWER Directive #9200.0-68. September 2008. Washington, D.C.: Office of Solid Waste and Emergency Response, United States Environmental Protection Agency.

Epler, G. R., M. X. Fitz Gerald, E. A. Gaensler, and C. B. Carrington. 1980. Asbestos-related disease from household exposure. Respiration 39 (4):229-40.

ERG (Eastern Research Group). 2003a. Report on the expert panel on health effects of asbestos and synthetic vitreous fibers: The influence of fiber length. Prepared for the Agency for Toxic Substances and Disease Registry (ATSDR), Division of Health Assessment and Consultation. 68-C-98-148. March 17, 2003. Lexington, MA: Eastern Research Group.

ERG (Eastern Research Group). 2003b. Report on the Peer Consultation Workshop to Discuss a Proposed Protocol to Assess Asbestos-Related Risk. Prepared for the U.S. Environmental Protection Agency (USEPA), Office of Solid Waste and Emergency Response. May 30, 2003. Lexington, MA: Eastern Research Group.

Esmen, N. A. 1996. Adhesion and Aerodynamic Resuspension of Fibrous Particles. Journal of Environmental Engineering 122 (5):379-383.

Estrin, N. F. 1976. Memo from Norman F. Estrin (Vice President, Science - Cosmetic, Toiletry and Fragrance Association Inc) to Mr. Heinz J. Eiermann (Food and Drug Administration), RE: Attached Letters Demonstrating Responsibility of Industry in Monitoring Its Talcs. Dated March 15, 1976.

Fahr. 1914. Aerztlicher Verein in Hamburg. Munch Med Wochenschr 61 (11):625-626.

Felton, J. S. 1979a. A comprehensive program in asbestos hazard surveillance and education. Am Ind Hyg Assoc J 40 (1):11-9.

Felton, J. S. 1979b. Radiographic search for asbestos-related disease in a naval shipyard. Ann N Y Acad Sci 330:341-52.

Ferrante, D., M. Bertolotti, A. Todesco, D. Mirabelli, B. Terracini, and C. Magnani. 2007. Cancer mortality and incidence of mesothelioma in a cohort of wives of asbestos workers in Casale Monferrato, Italy. Environ Health Perspect 115 (10):1401-5.

Finkelstein, M. M. 1982. Asbestosis in long-term employees of an Ontario asbestos-cement factory. Am Rev Respir Dis 125 (5):496-501.

Finkelstein, M. M. 1983. Mortality among long-term employees of an Ontario asbestos-cement factory. Br J Ind Med 40 (2):138-44.

Finkelstein, M. M., and A. Dufresne. 1999. Inferences on the kinetics of asbestos deposition and clearance among chrysotile miners and millers. American Journal of Industrial Medicine 35 (4):401-12.

Finley, B. L., J. S. Pierce, A. D. Phelka, R. E. Adams, D. J. Paustenbach, K. A. Thuett, and C. A. Barlow. 2012. Evaluation of tremolite asbestos exposures associated with the use of commercial products. Crit Rev Toxicol 42 (2):119-46.

Finley, B. L., R. O. Richter, F. S. Mowat, S. Mlynarek, D. J. Paustenbach, J. M. Warmerdam, and P. J. Sheehan. 2007. Cumulative asbestos exposure for US automobile mechanics involved in brake repair (circa 1950s-2000). J Expo Sci Environ Epidemiol 17 (7):644-55.

First, M. W., and L. Silverman. 1953. Air sampling with membrane filters. AMA Arch Ind Hyg Occup Med 7 (1):1-11.

Fischbein, A., A. N. Rohl, A. M. Langer, and I. J. Selikoff. 1979. Drywall construction and asbestos exposure. Am Ind Hyg Assoc J 40 (5):402-7.

Fishbein, M. (ed.). 1949. Asbestosis and Cancer of the Lung. JAMA 140 (9):1219-1220.

Fiume, M. M., I. Boyer, W. F. Bergfeld, D. V. Belsito, R. A. Hill, C. D. Klaassen, D. C. Liebler, J. G. Marks, Jr., R. C. Shank, T. J. Slaga, P. W. Snyder, and F. A. Andersen. 2015. Safety Assessment of Talc as Used in Cosmetics. Int J Toxicol 34 (1 Suppl):66S-129S.

Fleischer, W. E., F. J. J. Viles, R. L. Gade, and P. Drinker. 1946. A health survey of pipe covering operations in constructing naval vessels. Journal of Industrial Hygiene and Toxicology 28 (1):9-16.

Fletcher, A. C., G. Engholm, and A. Englund. 1993. The risk of lung cancer from asbestos among Swedish construction workers: Self-reported exposure and a job exposure matrix compared. International Journal of Epidemiology 22 Suppl 2:S29-35.

Fowler, D. P. 2000. Exposures to asbestos arising from bandsawing gasket material. Applied Occupational and Environmental Hygiene 15 (5):404-8.

Fowler, D. P., and E. J. Chatfield. 1997. Surface sampling for asbestos risk assessment. Annals of Occupational Hygiene 41 (inhaled particles VIII):279-286.

Franke, K., and D. Paustenbach. 2011. Government and Navy knowledge regarding health hazards of asbestos: a state of the science evaluation (1900 to 1970). Inhal Toxicol 23 Suppl 3:1-20.

Fraser, D. A. 1953. Absolute method of sampling and measurement of solid air-borne particulates; combined use of the molecular filter membrane and electron microscopy. AMA Arch Ind Hyg Occup Med 8 (5):412-19.

Frederick, W. G. 1968. The birth of the ACGIH Threshold Limit Values Committee and its influence on the development of industrial hygiene. In Transactions of the Thirtieth Annual Meeting of the American Conference of Governmental Industrial Hygienists. St. Louis, Missouri, May 12-14, 1968. Cincinnati, OH: American Conference of Governmental Industrial Hygienists. p. 40-42.

Frederick, W. G. 1984. The birth of the ACGIH Threshold Limit Values committee and its influence on the development of industrial hygiene. In Threshold Limit Values: Discussion and Thirty-Five Year Index with Recommendations. Annals of the American Conference of Industrial Hygienists: Volume 9, edited by M. E. LaNier. Cincinnati, OH: American Conference of Governmental Industrial Hygienists. p. 11-13.

Frost, J., J. Georg, and P. F. Moller. 1956. Asbestosis with pleural calcification among insulation workers. Dan Med Bull 3 (7):202-4.

Fulton, W. B., A. Dooley, J. L. Matthews, and R. L. Houtz. 1935. Asbestosis: Part II: The Nature and Amount of Dust Encountered in Asbestos Fabricating Plants, Part III: The Effects of Exposure to Dust Encountered in Asbestos Fabricating Plants on the Health of a Group of Workers. Special Bulletin No. 42. September 20, 1935. Harrisburg, PA: Industrial

Hygiene Section, Bureau of Industrial Standards, Commonwealth of Pennsylvania Dept. of Labor and Industry.

Fulton, W. B., and J. L. Matthews. 1936. A Preliminary Report of the Dermatological and Systemic Effects of Exposure to Hexachloro-napthalene and Chloro-diphenyl. Special Bulletin No. 43. March 16, 1936. Harrisburg, PA: Bureau of Industrial Standards.

Gaafar, R. M., and N. H. Eldin. 2005. Epidemic of mesothelioma in Egypt. Lung Cancer 49 Suppl 1:S17-20.

Gaffney, S. H., J. Sahmel, K. Devlin, and D. Paustenbach. 2010. Exposure Reconstruction and Cancer Risk Estimate Derivation. In Cancer Risk Assessment: Chemical Carcinogenesis, Hazard Evaluation, and Risk Quantification, edited by C. Hsu and T. Stedeford. Hoboken, NJ: John Wiley and Sons. p. 736-784.

Gamble, J., A. Greife, and J. Hancock. 1982. An Epidemiological-Industrial Hygiene Study of Talc Workers. Ann Occup Hyg 26 (8):841-859.

Gardner, L. U. 1937. The Similarity of the Lesions Produced by Silica and by the Tubercle Bacillus. Am J Pathol 13 (1):13-24 3.

Gardner, L. U. 1938a. Interim Report on Experimental Asbestosis at the Saranac Laboratory. (unpublished)

Gardner, L. U. 1938b. Progress Report on Asbestos Experiments. December 9, 1938

Gardner, L. U. 1938c. Second Progress Report on Experimental Asbestosis by the Saranac Laboratory. April 18, 1938.

Gardner, L. U. 1946. Memorandum from Leroy U. Gardner to Mr. J. P. Woodard. Saranac Lake, NY: The Saranac Laboratory for the Study of Tuberculosis. April 8, 1946.

Gardner, M. J., P. D. Winter, B. Pannett, and C. A. Powell. 1986. Follow up study of workers manufacturing chrysotile asbestos cement products. Br J Ind Med 43 (11):726-32.

George, A. W., and R. D. Leonard. 1939. An x-ray study of the lungs of workmen in the asbestos industry, covering a period of ten years. Radiol. 33 (2):196-202.

Gibbs, A. R. 1990. Role of asbestos and other fibres in the development of diffuse malignant mesothelioma. Thorax 45 (9):649-54.

Gibbs, A. R., D. M. Griffiths, F. D. Pooley, and J. S. Jones. 1990. Comparison of fibre types and size distributions in lung tissues of paraoccupational and occupational cases of malignant mesothelioma. Br J Ind Med 47 (9):621-6.

Gibbs, A. R., J. S. Jones, F. D. Pooley, D. M. Griffiths, and J. C. Wagner. 1989. Non-occupational malignant mesotheliomas. IARC Sci Publ (90):219-28.

Gilson, J. C. 1965. Problems and perspectives: The changing hazards of exposure to asbestos. Ann NY Acad Sci 132 (1):696-705.

Glynn, M. E., K. A. Keeton, S. H. Gaffney, and J. Sahmel. 2018. Ambient asbestos fiber concentrations and long-term trends in pleural mesothelioma incidence between urban and rural areas in the United States (1973-2012). Risk Analysis 38 (3):454-471.

Godbey, F. W., T. C. Cooper, J. W. Sheehy, D. M. O'Brien, H. D. Van Wagenen, J. D. McGlothlin, and W. F. Todd. 1987. In-Depth Survey Report: Evaluation of Brake Drum Service Controls at United States Postal Service Vehicle Maintenance Facility in Nashville, Tennessee. August 1987. National Institute for Occupational Safety and Health: Cincinnati, OH.

Goetz, A. 1953. Application of molecular filter membranes to the analysis of aerosols. Am J Public Health Nations Health 43 (2):150-9.

Goswami, E., V. Craven, D. L. Dahlstrom, D. Alexander, and F. Mowat. 2013. Domestic asbestos exposure: a review of epidemiologic and exposure data. Int J Environ Res Public Health 10 (11):5629-70.

Greenberg, M., and T. A. Davies. 1974. Mesothelioma register 1967-68. Br J Ind Med 31 (2):91-104.

Greenburg, L. 1928. Medicine Develops with Industry's Needs. National Safety News 18 (2):15-17.

Grexa, R. W., and C. J. Parmentier. 1979. Cosmetic talc properties and specifications. Cosmetics & Toiletries 94:29-33.

Gunter, B. J., and A. Albers. 1983. HETA 83-040-1356. Drive Train Industries, Inc., Casper, Wyoming. August 1983. Cincinnati, OH: Hazard Evaluations and Technical Assistance Branch, National Institute of Occupational Safety and Health.

Gunter, M. E., E. Belluso, and A. Mottana. 2007. Amphiboles: Environmental and health concerns. Reviews in Mineralogy & Geochemistry 67:453-516.

Gustavsson, P., N. Plato, E. B. Lidstrom, and C. Hogstedt. 1990. Lung cancer and exposure to diesel exhaust among bus garage workers. Scandinavian Journal of Work, Environment and Health 16 (5):348-54.

Gypsum Association. 1973. Evaluation of exposure to asbestos during mixing and sanding of joint compound. Denver, Colorado. November 19, 1973.

Hamer, D. H., F. R. Rolle, and J. P. Schelz. 1976. Characterization of talc and associated minerals. American Industrial Hygiene Association Journal 37 (5):296-304.

Hamlin, L. E. 1951. Industrial Hygiene: Industrial Dusts - What Every Supervisor Should Know. In Current Safety Topics in Industrial Safety, Volume 15, Transactions, 39th National Safety Congress. Chicago, IL: National Safety Council, p. 55-57.

Hammond, E. C., and I. J. Selikoff. 1973. Relation of cigarette smoking to risk of death of asbestos-associated disease among insulation workers in the United States. In Biological

Effects of Asbestos: Proceedings of a Working Conference held at the International Agency for Research on Cancer, 2-6 October 1972, edited by P. Bogovski, V. Timbrell, J. C. Gilson and J. C. Wagner. Lyon, France: World Health Organization, International Agency for Research on Cancer. p. 312-317.

Hannon, J. W. G., P. Cartier, R. K. Childerhose, D. T. Dubow, G. W. H. Schepers, R. Smart, H., and R. E. Whitehead. 1964. Asbestosis; Report of the Section on Nature and Prevalence, Committee on Occupational Diseases of the Chest, American College of Chest Physicians. Diseases of the Chest 45:107-11.

Hansen, J., and A. Meersohn. 2003. Cancer mortality among Danish employees (1970-1997) by industry classification [Kraeftsygelighed blandt danske lonmodtagere (1970-97) fordelt pa Arbejdstilsynets 49 branchegrupper]. Kraeftens Bekaempelse, Kobenhavn: Institut for Epidemiologisk Kraeftforskning.

Hardy, H. L. 1948. Delayed chemical pneumonitis in workers exposed to beryllium compounds. American Review of Tuberculosis 57 (6):547-56.

Harries, P. G. 1968. Asbestos hazards in naval dockyards. Ann Occup Hyg 11 (2):135-45.

Harries, P. G. 1971a. Asbestos dust concentrations in ship repairing: a practical approach to improving asbestos hygiene in naval dockyards. Annals of Occupational Hygiene 14 (3):241-54.

Harries, P. G. 1971b. A comparison of mass and fibre concentrations of asbestos dust in shipyard insulation processes. Ann Occup Hyg 14 (3):235-40.

Hatch, D. 1970. Possible alternatives to asbestos as a friction material. Ann Occup Hyg 13 (1):25-9.

Hatfield, R. L., and W. E. Longo. 1998. Sanding Clutch Plates Borg-Warner Work Place Simulation Demonstration. Raleigh, NC: Materials Analytical Services, Inc.

Hayes, A. J. 1957. Labor's Stake in Safety. In Current Safety Topics, Labor Safety, Volume 15, Transactions of the 45th National Safety Congress, October 21-25, 1957. Chicago, IL: National Safety Council, p. 16-21.

Health Canada. 2007. Chrysotile Asbestos Consensus Statement and Summary: Chrysotile Asbestos Expert Panel. Montreal, Quebec: November 13-14, 2007. Montreal, Quebec: Health Canada.

Heffelfinger, R. E., C. W. Melton, and D. L. Kiefer. 1972. Development of a Rapid Survey Method of Sampling and Analysis for Asbestos in Ambient Air: Final Report Covering the Period July 1969 Through July 1971. February 29, 1972. Research Triangle Park, N.C.: U.S. Environment Protection Agency, Division of Atmospheric Surveillance.

HEI-AR. 1991. Asbestos in Public and Commercial Buildings: A Literature Review and Synthesis of Current Knowledge. Cambridge, MA: Health Effects Institute-Asbestos Research.

Heller, R. M., M. L. Janower, and A. L. Weber. 1970. The radiological manifestations of malignant pleural mesothelioma. Am J Roentgenol Radium Ther Nucl Med 108 (1):53-9.

Hemeon, W. C. L. 1947. Report of Perliminary Dust Investigation for the Asbestos Textile Institute, Pittsburgh, PA: Industrial Hygiene Foundation.

Henderson, V. L., and P. E. Enterline. 1979. Asbestos exposure: factors associated with excess cancer and respiratory disease mortality. Ann N Y Acad Sci 330:117-26.

Henschler, D. 1984. Exposure limits: history, philosophy, future developments. Ann Occup Hyg 28 (1):79-92.

Henshaw, J. L. 2004. Letter from John L. Henshaw (Assistant Secretary, U. S. Dept. of Labor) to Senator Patty Murray dated February 10, 2004, RE: Questions Relating to Asbestos-Containing Brake Parts.

Henshaw, J. L. 2007. 2006 Henry F. Smyth Jr. Award lecture historical review--employer responsibility for workplace health and safety. Journal of Occupational and Environmental Hygiene 4 (2):D15-20.

Henshaw, J. L., S. H. Gaffney, A. K. Madl, and D. J. Paustenbach. 2007. The employer's responsibility to maintain a safe and healthful work environment: An historical review of societal expectations and industrial practices. Employ Respons Rights J 19:173-192.

Hertlein, F. 1974. Memorandum to Safety Director, Pearl Habor Naval Shipyard, Re: Asbestos Dust Counts During Shipboard Asbestos Operations, and Enclosures. San Francisco: Department of the Navy, Navy Regional Medical Clinic, August 12, 1974. August 12, 1974.

Hervin, R. L., R. Rivera, and J. P. Flesch. 1973. Health Hazard Evaluation/Toxicity Determination, HHE 72-91-37. Mobil Oil Corporation, Augusta, Kansas. April 1973. Cincinnati, OH: National Institute for Occupational Safety and Health.

Hickish, D. E., and K. L. Knight. 1970. Exposure to asbestos during brake maintenance. Ann Occup Hyg 13 (1):17-21.

Hildick-Smith, G. Y. 1976. The biology of talc. Br J Ind Med 33 (4):217-29.

Hilt, B., A. Andersen, J. Rosenberg, and S. Langard. 1991. Cancer incidence among asbestos-exposed chemical industry workers: An extended observation period. American Journal of Industrial Medicine 20 (2):261-4.

Hinds, W. C. 1982. Aerosol technology: Properties, Behavior, and Measurement of Airborne Particles. New York: J. Wiley.

Hinds, W. C. 1999. Aerosol Technology: Properties, Behavior, and Measurement of Airborne Particles. Second edition. New York, NY: Wiley.

Hinds, W. C. 1999. Optical properties. In Aerosol Technology Properties, Behavior, and Measurement of Airborne Particles, edited by W. C. Hinds. New York: Wiley. p. 349-378.

HM Factory Inspectorate. 1973. Probable Asbestos Dust Concentrations at Construction Processes. Technical Data Note 42. U.K.: Department of Employment, H.M. Factory Inspectorate.

Hodgson, J. T., and A. Darnton. 2000. The quantitative risks of mesothelioma and lung cancer in relation to asbestos exposure. Ann Occup Hyg 44 (8):565-601.

Hodgson, J. T., D. M. McElvenny, A. J. Darnton, M. J. Price, and J. Peto. 2005. The expected burden of mesothelioma mortality in Great Britain from 2002 to 2050. Br J Cancer 92 (3):587-93.

Hogan, B. W. 1955. Memorandum to All Ships and Stations Regarding Threshold Limit Values for Toxic Materials - Bureau of Medicine and Surgery (BUMED) Instruction 6270.3 - With Attached Table of Threshold Limit Values. November 7, 1955. Washington, D.C.: Department of the Navy, Bureau of Medicine and Surgery.

Hollins, D. M., D. J. Paustenbach, K. Clark, and C. A. Mangold. 2009. A visual historical review of exposure to asbestos at Puget Sound Naval Shipyard (1962-1972). J Toxicol Environ Health B Crit Rev 12 (2):124-56.

Holt, L. E. J. 1923. Lead poisoning in infancy. American Journal of Diseases of Children 25 (3):229-233.

Home Office. 1935. Memorandum on the Industrial Diseases of Silicosis and Asbestosis. February 1935. London: His Majesty's Stationery Office.

Horai, Z., T. Tsujimoto, M. Ueshima, and H. Sano. 1958. Studies on asbestosis: III. A survey of the asbestosis in an asbestos factory in 1956. Journal of Nara Medical Association 9 (1):48-56.

Howel, D., L. Arblaster, L. Swinburne, M. Schweiger, E. Renvoize, and P. Hatton. 1997. Routes of asbestos exposure and the development of mesothelioma in an English region. Occup Environ Med 54 (6):403-9.

Hrubec, Z., A. E. Blair, E. Rogot, and J. Vaught. 1992. Volume I: Mortality Risks by Occupation Among US Veterans of Known Smoking Status: 1954-1980. NIH Publication No. 92-3407. Bethesda, MD: U.S. Department of Health and Human Services, Public Health Service, National Institute of Health.

Hueper, W. C. 1942. Occupational Tumors and Allied Diseases. Springfield, IL: Charles C Thomas.

Hueper, W. C. 1946a. Industrial management and occupational cancer. J Am Med Assoc 131:738-41.

Hueper, W. C. 1946b. Significance of industrial cancer in the problem of cancer. Occupational medicine 2:190-200.

Hueper, W. C. 1948. Environmental and Occupational Cancer, Supplement 209, Public Health Reports: Federal Security Agency, Public Health Service.

Hueper, W. C. 1950. Present and potential occupational cancer hazards and carcinogenic operations in modern industry. Southern medical journal 43 (2):118-24.

Hueper, W. C. 1952. Occupational cancer hazards in American industries. AMA Arch Ind Hyg Occup Med 5 (3):204-8.

Hueper, W. C. 1955. Silicosis, asbestosis, and cancer of the lung. Am J Clin Pathol 25 (12):1388-90.

Hueper, W. C. 1957. Role of occupational and environmental air pollutants in production of respiratory cancers. AMA Arch Pathol 63 (5):427-50.

Hueper, W. C. 1957a. Newer developments in occupational and environmental cancer. A.M.A. archives of internal medicine 100 (3):487-503.

Hueper, W. C. 1957b. Role of occupational and environmental air pollutants in production of respiratory cancers. AMA Arch Pathol 63 (5):427-50.

Hueper, W. C. 1962. Symposium on chemical carcinogenesis. I. Environmental and occupational cancer hazards. Clinical pharmacology and therapeutics 3:776-813.

Hueper, W. C. 1965. Occupational and nonoccupational exposures to asbestos. Ann N Y Acad Sci 132 (1):184-95.

Hueper, W. C. 1966. Occupational and Environmental Cancers of the Respiratory System. Berlin, Heidelberg, New York: Springer-Verlag.

Hunt, R. B. 1936. Occupational Diseases: The Lesser Known Facts About Common Occupational Diseases. In Transactions, 25th National Safety Congress, October 5-9, 1936. Atlantic City, NJ: National Safety Council, p. 117-121.

Hunter, D. 1955. The pneumoconioses: treatment of silicosis, asbestos and other fibrous silicates. In The diseases of occupations. Boston: Little, Brown and Company. p. 873-885, 949.

IARC (International Agency for Research on Cancer). 1977. Asbestos. In IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Volume 14. Lyon: World Health Organization, International Agency for Research on Cancer (IARC). p. 11-81.

IARC (International Agency for Research on Cancer). 1987. Talc. In IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans: Silica and Some Silicates. Lyon, France: International Agency for Research on Cancer. p. 185-224.

IARC (International Agency for Research on Cancer). 1997. United States of America. In Cancer incidence in five continents. Volume VII. IARC Scientific Publications No. 143, edited by D. M. Parkin, S. L. Whelen, J. Ferlay, L. Raymond and J. Young. Lyon: International Agency for Research on Cancer

IARC (International Agency for Research on Cancer). 2010. Talc. In IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Volume 93, Carbon Black, Titanium Dioxide, and Talc, edited by IARC. Lyon: WHO. p. 277-413.

IARC (International Agency for Research on Cancer). 2012. Volume 100: A Review of Carcinogens. Part C: Arsenic, Metals, Fibres, and Dusts. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans: Volume 100C. Lyon, France: International Agency for Research on Cancer.

ICF Incorporated. 1988. Asbestos Exposure Assessment: Revised Report. Prepared for Dr. Wong, Chemical Engineering Branch, Office of Pesticides and Toxic Substances, U.S. Environmental Protection Agency. March 21, 1988. Fairfax, VA: ICF Incorporated.

Ignacio, J., and W. Bullock. 2006. A Strategy for Assessing and Managing Occupational Exposure. Third edition. Fairfax, VA: American Industrial Hygiene Association Press.

ISO (International Organization for Standardization). 1995. SO 10312 Ambient air - Determination of asbestos fibres -Direct-transfer transmission electron microscopy method. ISO10312:1995E. First Edition. May 1, 1995. Geneva, Switzerland: International Organization for Standardization.

ISO (International Organization for Standardization). 2009. SO 10312 Ambient air - Determination of asbestos fibres -Direct-transfer transmission electron microscopy method. ISO10312:1995E. First Edition. May 1, 1995. Geneva, Switzerland: International Organization for Standardization.

Isselbacher, K. J., H. Klaus, and H. L. Hardy. 1953. Asbestosis and bronchogenic carcinoma; Report of one autopsied case and review of the available literature. American Journal of Medicine 15 (5):721-32.

Jacko, M. G., and R. T. DuCharme. 1973a. Brake Emissions: Emission Measurements from Brake and Clutch Linings from Selected Mobile Sources. EPA 68-04-0020. March 1973. Ann Arbor, MI: Environmental Protection Agency, Office of Air and Water Programs.

Jacko, M. G., R. T. DuCharme, and J. H. Somers. 1973b. Brake and Clutch Emissions Generated During Vehicle Operation, SAE Paper No. 730548. New York, NY: Society of Automotive Engineers, Inc.

Jackson, H. M. 1964. Personal correspondence between H.M. Jackson and W.T. Marr.

Jaffrey, S. A. M. T. 1990. Environmental Asbestos Fibre Release from Brake and Clutch Linings in Vehicular Traffic. Annals of Occupational Hygiene 34 (5):529-534.

Jahn, H., K. Rodelsperger, B. Bruckel, J. Manke, and H. J. Woitowitz. 1985. [Asbestos dust risks in brake repair services]. Staub-Reinhaltung der Luft 45:80-83.

Jahn, S. D., W. H. Bullock, and J. S. Ignacio. 2015. A Strategy for Assessing and Managing Occupational Exposures. 4th Edition. Fairfax, VA: AIHA.

Jayjock, M. A., J. R. Lynch, and D. I. Nelson. 2000. Risk Assessment Principles for the Industrial Hygienist. Fairfax, VA: American Industrial Hygiene Association Press.

Jeffress, C. N. 1999. Letter to W.L. Dyson, Workplace Hygiene, Re: Clarification of OSHA's Risk Assessment and Approach for Setting the Asbestos PEL.[1910.1001(c); 1926.1101(c)]. Accessed July 23, 1999: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=22770.

Jiang, G. C., A. K. Madl, K. J. Ingmundson, D. M. Murbach, K. A. Fehling, D. J. Paustenbach, and B. L. Finley. 2008. A study of airborne chrysotile concentrations associated with handling, unpacking, and repacking boxes of automobile clutch discs. Regul Toxicol Pharmacol 51 (1):87-97.

Johnson, A. S. 1935. No Half Way Measures in Dust Control. National Safety News 32 (3):17-18, 48-51.

Johnson, P., R. D. Zumwalde, and D. Roberts. 1976. Preliminary Industrial Hygiene Survey at Auto Brake Clinic, Cincinnati, Ohio. August 8, 1976. Cincinnati, OH: Industrial Hygiene Section, Industry-wide Studies Branch, Division of Surveillance, Hazard Occupations, and Field Studies, National Institute for Occupational Safety and Health.

Johnson, P., R. D. Zumwalde, and D. Roberts. 1979. Industrial Hygiene Assessment of Seven Brake Servicing Facilities. January 29, 1979. Cincinnati, OH: Division of Surveillance, Hazard Evaluations, and Field Studies, National Institute of Occupational Safety and Health.

Jolicoeur, C. R., J. F. Alary, and A. Sokov. 1992. Asbestos. In Encyclopedia of Chemical Technology, edited by M. Howe-Grant. New York: John Wiley and Sons. p. 659-688.

Joubert, L., H. Seidman, and I. J. Selikoff. 1991. Mortality experience of family contacts of asbestos factory workers. Ann N Y Acad Sci 643:416-8.

Kakooei, H., M. Hormozy, and H. Marioryad. 2011. Evaluation of asbestos exposure during brake repair and replacement. Ind Health 49 (3):374-80.

Kaminski, R., K. S. Geissert, and E. Dacey. 1980. Mortality analysis of plumbers and pipefitters. J Occup Med 22 (3):183-9.

Kauppinen, T., and K. Korhonen. 1987. Exposure to asbestos during brake maintenance of automotive vehicles by different methods. Am Ind Hyg Assoc J 48 (5):499-504.

Keil, C. B. 2000a. Mathematical models for estimating occupational exposure to chemicals. Fairfax, VA: American Industrial Hygiene Association.

Keil, C. B. 2000b. A tiered approach to deterministic models for indoor air exposures. Appl Occup Environ Hyg 15 (1):145-51.

Keil, C. B., C. E. Simmons, and T. R. Anthony. 2009. Mathematical Models for Estimating Occupational Exposure. Second edition. Fairfax, VA: American Industrial Hygiene Association Press.

Kemplin, M. G. 1980. Dry wall construction and asbestos exposure. Am Ind Hyg Assoc J 41 (6):462.

Kilburn, K. H., R. Lilis, H. A. Anderson, C. T. Boylen, H. E. Einstein, S. J. Johnson, and R. Warshaw. 1985. Asbestos disease in family contacts of shipyard workers. Am J Public Health 75 (6):615-7.

Kleinfeld, M., J. Messite, and A. M. Langer. 1973. A study of workers exposed to asbestiform minerals in commercial talc manufacture. Environ Res 6 (2):132-43.

Kleinfeld, M., J. Messite, and I. R. Tabershaw. 1955. Talc pneumoconiosis. AMA Arch Ind Health 12 (1):66-72.

Knappmann, J. 1972. [Observations made at post mortem examination in 251 cases of mesothelioma in Hamburg (1958-1968)]. Pneumonologie 148 (1):60-5.

Knight, K. L., and D. E. Hickish. 1970. Investigations into alternative forms of control for dust generated during the cleaning of brake assemblies and drums. Ann Occup Hyg 13 (1):37-9.

Knowlson, J. S. 1942. Part 1064- Asbestos: Conservation Order M-79 Curtailing the Use of Certain Types of Asbestos, January 21, 1942. Federal Register 7 (1-22):436.

Knox, J. F., and J. Beattie. 1954. Mineral content of the lungs after exposure to asbestos dust. AMA Archives of Industrial Hygiene and Occupational Medicine 10 (1):23-9.

Kominsky, J. R., R. W. Freyberg, P. J. Clark, B. A. Hollett, A. Edwards, R. C. Wilmoth, J. M. Boiano, and K. A. Brackett. 1998. Asbestos exposure during routine floor tile maintenance. Part 2: Ultra high speed burnishing and wet-stripping. Appl Occup Environ Hyg 13 (2):107-112.

Kopelovich, L. M., K. A. Thuett, P. S. Chapman, and D. J. Paustenbach. 2014. History and evolution of warning labels for automotive friction products. Regul Toxicol Pharmacol 68 (3):402-11.

Koskinen, K., E. Pukkala, R. Martikainen, K. Reijula, and A. Karjalainen. 2002. Different measures of asbestos exposure in estimating risk of lung cancer and mesothelioma among construction workers. J Occup Environ Med 44 (12):1190-6.

Kotin, P., and W. C. Hueper. 1955. Relationship of industrial carcinogens to cancer in the general population. Public health reports 70 (3):331-3.

Krafcisin, G. J. 1979. Comments. Am Ind Hyg Assoc J 40 (9):829-830.

Kuhn, T. S. 2012. The Structure of Scientific Revolutions: 50th Anniversary Edition. Chicago, IL: The University of Chicago Press.

Kurumatani, N., Y. Natori, R. Mizutani, S. Kumagai, M. Haruta, H. Miura, and K. Yonemasu. 1999. A historical cohort mortality study of workers exposed to asbestos in a refitting shipyard. Ind Health 37 (1):9-17.

Lacquet, L. M., L. van der Linden, and J. Lepoutre. 1980. Roentgenographic lung changes, asbestosis and mortality in a Belgian asbestos-cement factory. IARC Sci Publ (30):783-93.

Lane, R. E., J. M. Barnes, D. E. Hickish, J. G. Jones, S. A. Roach, and E. King. 1968. Hygiene standards for chrysotile asbestos dust from the Committee on Hygiene Standards of the British Occupational Hygiene Society. Ann Occup Hyg 11:47-69.

Lange, J. H. 2002. Impact of asbestos concentrations in floor tiles on exposure during removal. Int J Environ Health Res 12:293-300.

Langer, A. M. 2003. Reduction of the biological potential of chrysotile asbestos arising from conditions of service on brake pads. Regul Toxicol Pharmacol 38 (1):71-7.

LaNier, M. E. 1984. Report of the sub-committee on threshold limits. In Threshold Limit Values: Discussion and Thirty-Five Year Index with Recommendations. Annals of the American Conference of Governmental Industrial Hygienists: Volume 9, edited by M. E. LaNier. Cincinnati, OH: American Conference of Governmental Industrial Hygienists. p. 343-345.

Lanza, A. J. 1936. Dust Diseases as They Affect the Construction Industry. In Transactions, 25th National Safety Congress, October 5-9, 1936. Atlantic City, NJ: National Safety Council, p. 244-246.

Lanza, A. J. 1938. History of silicosis and asbestosis. In Silicosis and Asbestosis. London: Oxford University Press. p. 3-30.

Lanza, A. J. 1952. Comments at the Seventh Saranac Symposium. Washington, D.C.: Vorwald Archives. September 24, 1952.

Lanza, A. J., W. J. McConnell, and J. W. Fehnel. 1935. Effects of the inhalation of asbestos dust on the lungs of asbestos workers. Public Health Rep 50 (1):1-12.

Lavento, M., and S. Hornytzkyj. 1995. On Asbestos Used as Temper in Finnish Subneolithic, Neolithic, and Early Metal Period Pottery. Fennoscandia Archaeologica XII:71-75.

Lawrence, W. E. 1943. General Subject and Industrial Sessions: The Control of Fumes in Shipyards. In Transactions, 32nd National Safety Congress, October 5-7, 1943. Chicago, IL: National Safety Council, p. 401-404.

Leahy, K. 2008. Asbestos Exposure and the Law in the United States. In Asbestos and Its Diseases, edited by J. E. Craighead and A. R. Gibbs. New York: Oxford University Press. p. 346-374.

Lee, R. J., and D. R. Van Orden. 2008. Airborne asbestos in buildings. Regul Toxicol Pharmacol 50 (2):218-25.

Lee, R. J., D. R. Van Orden, M. Corn, and K. S. Crump. 1992. Exposure to airborne asbestos in buildings. Regul Toxicol Pharmacol 16 (1):93-107.

Lee, R., and D. Van Orden. 2015. Asbestos in commercial cosmetic talcum powder as a cause of mesothelioma in women. International Journal of Occupational and Environmental Health 21 (4):337-41.

Lerer, T. J., C. K. Redmond, P. P. Breslin, L. Salvin, and H. W. Rush. 1974. Long-Term Mortality Study of Steelworkers: VII. Mortality Patterns Among Crane Operators. Journal of Occupational and Environmental Medicine 16 (9):608-614.

Lick, H. B. 1973a. Inter-Office Memo from Henry B. Lick (Ford Motor Company) to Mr. J.A. Keller (Ford Motor Company), RE: Asbestos Fiber Air Sampling - Arizona Proving Grounds, With Attached Data Sheets. May 29, 1973.

Lick, H. B. 1973b. Intra office correspondence to J.A. Keller, R.M. Quarles, and M.A. Harris regarding asbestos in air sampling- research and engineering, with attached data sheet/report re: brake-drum decomposition products-current research areas for March 1973-March 1974: Ford Motor Company. March 7.

Liddell, F. D., A. D. McDonald, and J. C. McDonald. 1997. The 1891-1920 birth cohort of Quebec chrysotile miners and millers: development from 1904 and mortality to 1992. Ann Occup Hyg 41 (1):13-36.

Liddell, F. D., A. D. McDonald, and J. C. McDonald. 1998. Dust exposure and lung cancer in Quebec chrysotile miners and millers. Ann Occup Hyg 42 (1):7-20.

Lieben, J., and H. Pistawka. 1967. Mesothelioma and asbestos exposure. Arch Environ Health 14 (4):559-63.

Lightfoot, J., G. A. Kingston, and F. D. Pooley. 1972. An Examination of Italian Mine Samples and Relevant Powders. Cardiff, UK: Cardiff University.

Lillington, G. A., R. W. Jamplis, and J. R. Differding. 1974. Letter: Conjugal malignant mesothelioma. N Engl J Med 291 (11):583-4.

Lindell, K. V. 1973. Industrial uses of asbestos. In Biological Effects of Asbestos, Proceedings of a Working Conference held at the International Agency for Research on Cancer (IARC), 2-6 October 1972. IARC Scientific Publication No. 8, edited by P. Bogovski, V. Trimbrell, J. C. Gilson and J. C. Wagner. Lyons, France: International Agency for Research on Cancer. p. 323-328.

Lippmann, M. 1988. Asbestos exposure indices. Environ Res 46 (1):86-106.

Liukonen, L. R., and F. W. Weir. 2005. Asbestos exposure from gaskets during disassembly of a medium duty diesel engine. Regul Toxicol Pharmacol 41 (2):113-21.

Liukonen, L. R., K. R. Still, and R. R. Beckett. 1978. Asbestos Exposure from Gasket Operations. May 1978. Bremerton, WA: Industrial Hygiene Branch Occupational and Environmental Health Service, Naval Regional Medical Center.

Lloyd, J. W. 1971. Long-term mortality study of steelworkers. V. Respiratory cancer in coke plant workers. J Occup Med 13 (2):53-68.

Lloyd, J. W., and A. Ciocco. 1969. Long-term mortality study of steelworkers. I. Methodology. Journal of Occupational Medicine 11 (6):299-310.

Lloyd, J. W., F. E. Lundin, Jr., C. K. Redmond, and P. B. Geiser. 1970. Long-term mortality study of steelworkers. IV. Mortality by work area. J Occup Med 12 (5):151-7.

Longo, W. E. 2003. Clutch & Brakebox Dust Analysis. Revision #0. May 2003. Suwanee, GA: Materials Analytical Services, Inc.

Longo, W. E., M. W. Rigler, and J. Slade. 1995. Crocidolite asbestos fibers in smoke from original Kent cigarettes. Cancer Res 55 (11):2232-5.

Longo, W. E., W. B. Egeland, R. L. Hatfield, and L. R. Newton. 2002. Fiber release during the removal of asbestos-containing gaskets: a work practice simulation. Applied Occupational and Environmental Hygiene 17 (1):55-62.

Loomis, D., J. M. Dement, S. H. Wolf, and D. B. Richardson. 2009. Lung cancer mortality and fibre exposures among North Carolina asbestos textile workers. Occup Environ Med 66 (8):535-42.

Lorimer, W. V., A. N. Rohl, A. Miller, W. J. Nicholson, and I. J. Selikoff. 1976. Asbestos exposure of brake repair workers in the United States. Mt Sinai J Med 43 (3):207-18.

Luckner, J. A., and D. Vail. 1977. Letter to California employers who use asbestos: Reporting asbestos use to Cal/OSHA. Sacramento: Department of Health. August 1977.

Luxon, S. 1970. Technical implementation of the new asbestos regulations. Ann Occup Hyg 13 (1):23-4.

Lynch, J. R. 1966. Results of Air Samples: Raybestos-Manhattan Textile Plant, Charleston, South Carolina. July 1966. Cincinnati, OH: Industrial Hygiene Section, Industry-Wide Studies Branch, Division of Surveillance, Hazard Evaluation and Field Studies, National Institute of Occupational Safety and Health.

Lynch, J. R. 1967. Memo from Jeremiah R. Lynch (Department of Health, Education, and Welfare, Public Health Service) to Daniel P. Maloney (Certain-Teed Products Corp), RE: Analysis of Air Samples Collected at Plant in December 1965. Dated April 14, 1967.

Lynch, J. R. 1968. Brake lining decomposition products. J Air Pollut Control Assoc 18 (12):824-6.

Lynch, J. R., and H. E. Ayer. 1966. Measurement of dust exposures in the asbestos textile industry. Am Ind Hyg Assoc J 27 (5):431-437.

Lynch, J. R., and H. E. Ayer. 1968. Measurement of asbestos exposure. Journal of Occupational Medicine 10 (1):21-4.

Lynch, J. R., H. E. Ayer, and D. L. Johnson. 1970. The interrelationships of selected asbestos exposure indices. American Industrial Hygiene Association Journal 31 (5):598-604.

Lynch, K. M. 1953. Potential occupational factors in lung cancer: Asbestos. In Cancer of the Lung: An Evaluation of the Problem, Proceedings of the Scientific Session, Annual Meeting, American Cancer Society, November 3-4, 1953, edited by American Cancer Society. Atlanta, GA: American Cancer Society. p. 115-118.

Lynch, K. M., and W. A. Smith. 1935. Pulmonary asbestosis III: Carcinoma of lung in asbesto-silicosis. The American Journal of Cancer 24:56-64.

Lynch, K. M., and W. M. Cannon. 1948. Asbestosis: VI. Analysis of forty necropsied cases. Dis Chest 14:874-885.

Madl, A. K., D. M. Hollins, K. D. Devlin, E. P. Donovan, P. J. Dopart, P. K. Scott, and A. L. Perez. 2014. Airborne asbestos exposures associated with gasket and packing replacement: A simulation study and meta-analysis. Regulatory Toxicology and Pharmacology 69 (3):304-19.

Madl, A. K., K. Clark, and D. J. Paustenbach. 2007. Exposure to airborne asbestos during removal and installation of gaskets and packings: a review of published and unpublished studies. J Toxicol Environ Health B Crit Rev 10 (4):259-86.

Madl, A. K., K. D. Devlin, A. L. Perez, D. M. Hollins, D. M. Cowan, P. K. Scott, K. White, T. J. Cheng, and J. L. Henshaw. 2015. Airborne asbestos exposures associated with gasket and packing replacement: A simulation study of flange and valve repair work and an assessment of exposure variables. Regulatory Toxicology and Pharmacology 71 (1):35-51.

Madl, A. K., L. L. Scott, D. M. Murbach, K. A. Fehling, B. L. Finley, and D. J. Paustenbach. 2008. Exposure to chrysotile asbestos associated with unpacking and repacking boxes of automobile brake pads and shoes. Ann Occup Hyg 52 (6):463-79.

Madl, A. K., S. H. Gaffney, J. L. Balzer, and D. J. Paustenbach. 2009. Airborne asbestos concentrations associated with heavy equipment brake removal. Ann Occup Hyg 53 (8):839-57.

Magnani, C., A. Agudo, C. A. Gonzalez, A. Andrion, A. Calleja, E. Chellini, P. Dalmasso, A. Escolar, S. Hernandez, C. Ivaldi, D. Mirabelli, J. Ramirez, D. Turuguet, M. Usel, and B. Terracini. 2000. Multicentric study on malignant pleural mesothelioma and non-occupational exposure to asbestos. Br J Cancer 83 (1):104-11.

Magnani, C., B. Terracini, C. Ivaldi, M. Botta, P. Budel, A. Mancini, and R. Zanetti. 1993. A cohort study on mortality among wives of workers in the asbestos cement industry in Casale Monferrato, Italy. Br J Ind Med 50 (9):779-84.

Mangold, C. 1982. The Actual Contribution of Garlock Asbestos Gasket Materials to the Occupational Exposure of Asbestos Workers. October 1982. Bellevue, WA: Environmental Control Sciences Inc.

Mangold, C. 1983. Asbestos Fibers in the Ambient Air in the Greater San Francisco Area. March 1983. Bellevue, WA: Environmental Control Sciences Inc.

Mangold, C. A. 2003. Amosite Insulation. Use of Amosite Insulations and Products Aboard U.S. Naval and Contract Ships in the 1940s, 1950s, 1960s, and 1970s. Bellevue, WA: Environmental Control Sciences Inc.

Mangold, C., K. Clark, A. Madl, and D. Paustenbach. 2006. An exposure study of bystanders and workers during the installation and removal of asbestos gaskets and packing. Journal of Occupational and Environmental Hygiene 3 (2):87-98.

Mann, E. L. 1983. Asbestos. In Industrial Minerals and Rocks, 5th Edition, edited by S. J. Lefond. New York: Society Mining Engineers of the American Institute of Mining, Metallurgical, and Petroleum Engineers. p. 435-484.

Marr, W. T. 1964. Asbestos Exposure During Naval Vessel Overhaul. American Industrial Hygiene Association Journal 25:264-8.

Massachusetts Department of Labor and Industries. 1968. Maximum allowable concentrations: Massachusetts Department of Labor and Industries, Division of Occupational Hygiene. February.

Mazumdar, S., T. Lerer, and C. K. Redmond. 1975. Long-term mortality study of steelworkers. IX. Mortality patterns among sheet and tin mill workers. J Occup Med 17 (12):751-5.

McConnell, E. E., H. A. Rutter, B. M. Ulland, and J. A. Moore. 1983. Chronic effects of dietary exposure to amosite asbestos and tremolite in F344 rats. Environ Health Perspect 53:27-44.

McCrone Associates. 1977. Analysis of Talc by X-Ray Diffraction and Polarized Light Microscopy. PB84-190651. May 1977. National Institute for Occupational Safety and Health: Cincinnati, OH.

McCulloch, J. 2002. Asbestos Blues: labour, capital, physicians, and the state in South Africa. Bloomington, IN: Indiana University Press.

McDonald, A. D., A. Harper, J. C. McDonald, and O. A. el-Attar. 1970. Epidemiology of primary malignant mesothelial tumors in Canada. Cancer 26 (4):914-9.

McDonald, A. D., and J. C. McDonald. 1973. Epidemiologic surveillance of mesothelioma in Canada. Can Med Assoc J 109 (5):359-62.

McDonald, A. D., and J. C. McDonald. 1980. Malignant mesothelioma in North America. Cancer 46 (7):1650-6.

McDonald, A. D., B. W. Case, A. Churg, A. Dufresne, G. W. Gibbs, P. Sebastien, and J. C. McDonald. 1997. Mesothelioma in Quebec chrysotile miners and millers: epidemiology and aetiology. Ann Occup Hyg 41 (6):707-19.

McDonald, A. D., J. S. Fry, A. J. Woolley, and J. C. McDonald. 1983. Dust exposure and mortality in an American factory using chrysotile, amosite, and crocidolite in mainly textile manufacture. Br J Ind Med 40 (4):368-74.

McDonald, A. D., J. S. Fry, A. J. Woolley, and J. C. McDonald. 1984. Dust exposure and mortality in an American chrysotile asbestos friction products plant. Br J Ind Med 41 (2):151-7.

McDonald, J. C. 1985. Health implications of environmental exposure to asbestos. Environ Health Perspect 62:319-28.

McDonald, J. C., and A. D. McDonald. 1977. Epidemiology of mesothelioma from estimated incidence. Prev Med 6 (3):426-446.

McDonald, J. C., and A. D. McDonald. 1997. Chrysotile, tremolite and carcinogenicity. Ann Occup Hyg 41 (6):699-705.

McDonald, J. C., and A. McDonald. 1994. Mesothelioma: Is There a Background? In The Mesothelial Cell and Mesothelioma, edited by M. Jaurand and J. Bignon. New York: Marcel Decker. p. 37-45.

McEwen, J., A. Finlayson, A. Mair, and A. A. Gibson. 1971. Asbestos and mesothelioma in Scotland. An epidemiological study. Int Arch Arbeitsmed 28 (4):301-11.

McKinnery, W. N., and R. W. Moore. 1992. Evaluation of airborne asbestos fiber levels during removal and installation of valve gaskets and packing. American Industrial Hygiene Association Journal 53 (8):531-532.

McPheeters, S. B. 1936. A survey of a group of employees exposed to asbestos dust. J Ind Hyg Toxicol 18 (4):229-239.

Meller, H. B. 1936a. Air Contaminants That Affect Health. National Safety News 34 (6):34, 36, 65.

Meller, H. B. 1936b. The Present Status of Control of Dust and Fumes in Industry. In Transactions, 25th National Safety Congress, October 5-9, 1936, edited by National Safety Council. Atlantic City, NJ: National Safety Council. p. 312-317.

Merewether, E. R. A. 1930. The occurrence of pulmonary fibrosis and other pulmonary affections in asbestos workers. Journal of Industrial Hygiene 12:198-222; 239-257.

Merewether, E. R. A. 1933. A Memorandum on Asbestosis. Tubercle 15:69-81, 109-118, 152-159.

Merewether, E. R. A. 1934. A memorandum on asbestosis. Tubercle 15 (4):152-159.

Merewether, E. R. A. 1949. Annual Report of the Chief Inspector of Factories for the Year 1947: Presented by the Minister of Labour and National Service to Parliament of Command of His Majesty. January 1949. London: His Majesty's Stationery Office.

Merewether, E. R. A. 1952. Comments at the Saranac Seventh Symposium. Washington, D.C.: Vorwald Archives.

Merewether, E. R. A., and C. W. Price. 1930. Report on Effects of Asbestos Dust on the Lungs and Dust Suppression in the Asbestos Industry. Part I and II. London: His Majesty's Stationery office.

Messite, J., G. Reddin, and M. Kleinfeld. 1959. Pulmonary talcosis, a clinical and environmental study. AMA Arch, Ind. Health 20:408-413.

Meurman, L. O., R. Kiviluoto, and M. Hakama. 1974. Mortality and morbidity among the working population of anthophyllite asbestos miners in Finland. Br J Ind Med 31 (2):105-12.

Meylan, W. M., P. H. Howard, S. S. Lande, and A. Hanchett. 1978. Final Report: Chemical Market Input/Output Analysis of Selected Chemical Substances to Assess Sources of Environmental Contamination: Task III. Asbestos. EPA 560/6-78-005. TR 77-515. August 1978. Washington, D.C.: Office of Toxic Substances, U.S. Environmental Protection Agency.

Michaels, L., and S. S. Chissick. 1979. Asbestos: Properties, applications, and hazards (Volume 1). Chichester: John Wiley and Sons.

Middendorf, P., R. Zumwalde, and R. Castellan. 2007. Draft Document NIOSH-099. Asbestos and Other Mineral Fibers: A Roadmap for Scientific Research. Cincinnati, OH: Department of Health and Human Services, Center for Disease Control and Prevention, National Institute for Occupational Safety and Health.

Miller, L. M., and J. Monahan. 1957. Wanted--and available--filter tips that really filter. Reader's Digest August:43-49.

Millette, J. R., and M. D. Mount. 1993. A study determining asbestos fiber release during the removal of valve packing. Applied Occupational and Environmental Hygiene 8 (9):790-793.

Milne, J. 1969. Fifteen cases of pleural mesothelioma associated with occupational exposure to asbestos in Victoria. Med J Aust 2 (14):669-73.

Ministry of Labour. 1960. Safety, health, and welfare: Toxic substances in factory atmospheres. Minister of Labour, New Series No. 8: London: Her Majesty's Stationery Office. March.

Mitchell, J. 1961. Health progress in an asbestos textile works. Arch Environ Health 3:37-41.

Mlynarek, S. P. 2007. Report: Assessment of Potential Asbestos Exposures from Jet Engine Overhaul Work: March 12-21, June 25-30, and November 12-17, 2006. May 9, 2007.

Mlynarek, S. P., and D. R. Van Orden. 2012a. Asbestos exposure from the overhaul of a Pratt & Whitney R2800 engine. Regul Toxicol Pharmacol 64 (2):189-194.

Mlynarek, S. P., and D. R. Van Orden. 2012b. Assessment of potential asbestos exposures from jet engine overhaul work. Regul Toxicol Pharmacol.

Modern Mechanix. 2014. Asbestos Umbrellas for Fireman (Jan, 1933) [cited April 16,, 2014]. Available from http://blog.modernmechanix.com/asbestos-umbrellas-for-firemen/.

Moolgavkar, S. H., R. Meza, and J. Turim. 2009. Pleural and peritoneal mesotheliomas in SEER: age effects and temporal trends, 1973-2005. Cancer Causes Control 20 (6):935-44.

Moorcroft, J. S., and M. J. Duggan. 1984. Rate of decline of asbestos fibre concentration in room air. Annals of Occupational Hygiene 28 (4):453-7.

Moore, A. J., R. J. Parker, and J. Wiggins. 2008. Malignant mesothelioma. Orphanet Journal of Rare Diseases 3:34.

Moore, L. L. 1988. Asbestos exposure associated with automotive brake repair in Pennsylvania. Am Ind Hyg Assoc J 49:A12-A13.

Mossman, B. T., J. Bignon, M. Corn, A. Seaton, and J. B. Gee. 1990. Asbestos: scientific developments and implications for public policy. Science 247 (4940):294-301.

Moulin, J. J., T. Clavel, D. Roy, B. Dananche, N. Marquis, J. Fevotte, and J. M. Fontana. 2000. Risk of lung cancer in workers producing stainless steel and metallic alloys. International Archives of Occupational and Environmental Health 73 (3):171-180.

Mowat, F., M. Bono, R. J. Lee, S. Tamburello, and D. Paustenbach. 2005. Occupational exposure to airborne asbestos from phenolic molding material (Bakelite) during sanding, drilling, and related activities. J Occup Environ Hyg 2 (10):497-507.

Murbach, D. M., A. K. Madl, K. M. Unice, J. S. Knutsen, P. S. Chapman, J. L. Brown, and D. J. Paustenbach. 2008. Airborne concentrations of asbestos onboard maritime shipping vessels (1978-1992). Annals of Occupational Hygiene 52 (4):267-79.

Murphy, R. L., Jr., B. G. Ferris, Jr., W. A. Burgess, J. Worcester, and E. A. Gaensler. 1971. Effects of low concentrations of asbestos. Clinical, environmental, radiologic and epidemiologic observations in shipyard pipe coverers and controls. New England Journal of Medicine 285 (23):1271-8.

Murray, H. M. 1907. Mr. H Montague Murray, MD, Called and Examined, Minutes of evidence. January 1907. p. 127-128.

Murray, T. H. 1988. Regulating asbestos: Ethics, politics, and the values of science. In The Health and Safety of Workers. Case Studies in the Politics of Professional Responsibility, edited by R. Bayer. New York: Oxford University Press. p. 271-292.

National Safety Council. 1963. Dusts, Fumes, and Mists in Industry. National Safety News 87 (6):89-105.

Navy Bureau of Ships. 1959. Military Specification: Insulation felt, thermal, asbestos fiber. ML-I-0015091B (SHIPS). December 15, 1959.

Navy Bureau of Ships. 1962. Military Specification: Insulation felt, thermal, asbestos fiber. ML-I-0015091C (SHIPS). July 3, 1962.

NCGIH (National Conference of Governmental Industrial Hygienists). 1938. Transactions of the First Annual Conference of Governmental Industrial Hygienists, Held at Washington, D.C., June 27-29, 1938.

NCI (National Cancer Institute). 2015. SEER Stat Fact Sheets: Lung and Bronchus Cancer. Accessed September 3, 2015: http://seer.cancer.gov/statfacts/html/lungb.html.

Newhouse, M. L., and H. Thompson. 1965. Mesothelioma of pleura and peritoneum following exposure to asbestos in the London area. Br J Ind Med 22 (4):261-9.

Newhouse, M. L., and K. R. Sullivan. 1989. A mortality study of workers manufacturing friction materials: 1941-86. Br J Ind Med 46 (3):176-9.

NFPA (National Fire Protection Agency). 1990. Hazard Identification System. NFPA 704. Quincy, MA: National Fire Protection Association.

Nicas, M. 2001. Modeling turbulent diffusion and advection of indoor air contaminants by Markov chains. American Industrial Hygiene Association Journal 62 (2):149-58.

Nicas, M. 2011. Mathematical modeling of indoor air contaminant concentrations. In Patty's Industrial Hygiene, edited by V. E. Rose and B. Cohrssen. Hoboken, NJ: John Wiley & Sons, Inc. p. 661-694.

Nicholson, W. J. 1987. Airborne Levels of Mineral Fibres in the Non-Occupational Environment.

Nicholson, W. J. 1986. Airborne Asbestos Health Assessment Update. EPA/600/8-84/003F. June 1986. Research Triangle Park, N.C.: Environment Criteria and Assessment Office, Office of Health and Environmental Assessment, United States Environmental Protection Agency.

Nicholson, W. 1983. Affidavit of William Nicholson, Ph.D., New York, dated November 8, 1983.

Nicholson, W. J. 1976. Case study 1: Asbestos--the TLV approach. Annals of the New York Academy of Sciences 271:152-69.

Nicholson, W. J. 1979. Investigation of Health Hazards in Brake Lining Repair and Maintenance Workers Occupationally Exposed to Asbestos, Task I: Description of Brake Materials, Work Practices and Exposure Levels During Brake Maintenance, dated January 3, 1979: Environmental Sciences Laboratory.

Nicholson, W. J. 1975. The asbestos exposure of insulation workmen. Insulation Hygiene Progress Reports 6 (1):1-4.

Nicholson, W. J., A. N. Rohl, I. Weisman, and I. J. Selikoff. 1980. Environmental asbestos concentrations in the United States. IARC Sci Publ (30):823-7.

Nicholson, W. J., D. A. Holaday, and H. Heimann. 1971. Direct and indirect occupational exposure to insulation dusts in United States shipyards. Annals of Occupational Hygiene 14:37-47.
Nicholson, W. J., D. A. Holaday, and H. Heimann. 1972. Direct and indirect occupational exposure to insulation dusts in United States shipyards. In Proceedings of an International Symposium on Safety and Health in Ship Building and Ship Repairing; Helsinki, Finland. Occupational Safety and Health Series: 27. Geneva, Switzerland: International Labour Organization. p. 37-47.
NIOSH (National Institute for Occupational Health and Safety). 1976. Revised Recommended Asbestos Standard. DHEW (NIOSH) Publication No. 77-169. December 1976. Cincinnati, OH: U.S. Dept. of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health.
NIOSH (National Institute for Occupational Health and Safety). 1984. NIOSH testimony to the U.S. Department of Labor: statement of the National Institute for Occupational Safety and Health at the public hearing on occupational exposure to asbestos. NIOSH Policy Statement. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. June 21, 1984.
NIOSH (National Institute for Occupational Safety and Health), and OSHA (Occupational Safety and Health Administration). 1980. Workplace exposure to asbestos: review and recommendations. NIOSH-OSHA Asbestos Work Group. DHHS (NIOSH) Publication No. 81-103. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health and Health Administration. April 1980.
NIOSH (National Institute for Occupational Safety and Health). 1964. Results of Air Samples, Raybestos-Manhattan Friction Products. Manheim, Pennsylvania. PB83104703. Cincinnati, OH: National Institute for Occupational Safety and Health. August 1964.
NIOSH (National Institute for Occupational Safety and Health). 1972. Criteria for a recommended standard: Occupational exposure to asbestos. HSM 72-10267. Washington, D.C.: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health.
NIOSH (National Institute for Occupational Safety and Health). 1975. Minutes of Occupational Exposures to Asbestos Dust from Brake Linings Meeting, with Attached Agenda for Brake Lining Meeting. July 21, 1975. Atlanta, GA: Department of Health, Education, and

Welfare, Centers for Disease Control, National Institute for Occupational Safety and Health. July 21, 1975.

NIOSH (National Institute for Occupational Safety and Health). 1977. NIOSH Method P&CAM 239: Asbestos Fibers in Air. NIOSH Manual of Analytical Methods (NMAM), Second Edition. March 30, 1977.

NIOSH (National Institute for Occupational Safety and Health). 1988. Talc. The National Institute for Occupational Safety and Health, September 28, 2011 [cited April 6, 2016]. Available from http://www.cdc.gov/niosh/pel88/14807-96.html.

NIOSH (National Institute for Occupational Safety and Health). 1994a. NIOSH Method 7400: Asbestos and other fibers by phase contrast microscopy. NIOSH Manual of Analytical Methods. Cincinnati, OH: National Institute for Occupational Safety and Health.

NIOSH (National Institute for Occupational Safety and Health). 1994b. NIOSH Method 7402: Asbestos by transmission electron microscopy (TEM). NIOSH Manual of Analytical Methods. DHHS Publication No. 94-113. Washington, D.C.: National Institute for Occupational Safety and Health.

NIOSH (National Institute for Occupational Safety and Health). 1994c. NIOSH Method 9000: Chrysotile asbestos by X-ray diffraction (XRD). NIOSH Manual of Analytical Methods (NMAM), Fourth Edition. DHHS Publication No. 94-113. Washington, D.C.: National Institute for Occupational Safety and Health.

NIOSH (National Institute for Occupational Safety and Health). 1994d. NIOSH Method 9002: Asbestos bulk by polarized light microscopy (PLM). NIOSH Manual of Analytical Methods. DHHS Publication No. 94-113. Washington, D.C.: National Institute for Occupational Safety and Health.

NIOSH (National Institute for Occupational Safety and Health). 1995. Report to Congress on workers' home contamination study conducted under the Worker's Family Protection Act (29 U.S.C. 671a). NIOSH Pub. No. 95-123. September 1995. Cincinnati, OH: U.S. Dept. of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

NIOSH (National Institute for Occupational Safety and Health). 1997. Mortality by Occupation, Industry and Cause of Death: 24 Reporting States (1984-1988). DHHS (NIOSH) Publication No. 97-114. Cincinnati, OH: U.S. Dept. of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. June 1997.

NIOSH (National Institute for Occupational Safety and Health). 2003. Work-Related Lung Disease Surveillance Report, 2002. May 2003. DHHS (NIOSH) Number 2003-11.

Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention.

NIOSH (National Institute for Occupational Safety and Health). 2008. Revised Draft, NIOSH Current Intelligence Bulletin, Asbestos Fibers and Other Elongated Mineral Particles: State of the Science and Roadmap for Research. Cincinnati, OH: U.S. Dept. of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. June 2008.

NIOSH (National Institute for Occupational Safety and Health). 2011. Current Intelligence Bulletin 62. Asbestos Fibers and Other Elongate Mineral Particles: State of the Science and Roadmap for Research. DHHS No. 2011-159. March 2011. Cincinnati, OH: Department of Health and Human Services, Centers for Disease and Prevention, National Institute for Occupational Safety and Health.

NIOSH (National Institute for Occupational Safety and Health). 2014. Workplace Safety and Health Topic: National Occupational Mortality Surveillance (NOMS). Cincinnati, OH: National Institute for Occupational Safety and Health (NIOSH). Updated July 9, 2014. http://www.cdc.gov/niosh/topics/noms.

NIOSH (National Institute for Occupational Safety and Health). 2017. Current Intelligence Bulletin: 68. NIOSH Chemical Carcinogen Policy. DHHS (NIOSH) Publication No. 2017–100. December 2016, edited by C. Whittaker, F. Rice, L. McKernan, D. Dankovic, T. Lentz, K. MacMahon, E. Kuempel, R. Zumwalde and P. Schulte. Atlanta, GA: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

NIOSH/OSHA. 1980. Workplace exposure to asbestos: review and recommendations. NIOSH-OSHA Asbestos Work Group. DHHS (NIOSH) Publication No. 81-103. November 1980. Rockville, MD: U.S. Dept. of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health.

Nokso-Koivisto, P., and E. Pukkala. 1994. Past exposure to asbestos and combustion products and incidence of cancer among Finnish locomotive drivers. Occupational and Environmental Medicine 51 (5):330-4.

Nolan, R. P., and A. M. Langer. 2001. Concentration and type of asbestos fibers in air inside buildings. In The Health Effects of Chrysotile Asbestos: Contribution of Science to Risk-Management Decisions. The Canadian Mineralogist Special Publication: 5, edited by R. P. Nolan, A. M. Langer, M. Ross, F. J. Wicks and R. F. Martin. Ottawa, Canada: Mineralogical Association of Canada. p. 39-51.

Nordmann, M. 1938. An occupational cancer of asbestos workers. Zeitschrift fur Krebsforschung 47:228-302.

Nowinski, P. A. 1982. Torts Branch Monograph (Asbestos): State-of-the-Art. U.S. Department of Justice, Civil Division Publication.

NRC (National Research Council). 1981. Indoor Pollutants. Washington, D.C.: National Academy Press.

NRC (National Research Council). 1983. The nature of risk assessment. In Risk Assessment in the Federal Government: Managing the Process, edited by NRC (National Research Council). Washington, D.C.: National Academy Press. p. 17-50.

NSC (National Safety Council). 1929. Dust: Health Practices Pamphlet No. 4. Chicago, IL: National Safety Council.

NSC (National Safety Council). 1939. Industrial Dust. Health Practices Pamphlet No. 4. Chicago, IL: National Safety Council.

NSC (National Safety Council). 1963. Dusts, Fumes, and Mists in Industry. National Safety News 87 (6):89-105.

NSC (National Safety Council). 1964. Orientation for newcomers or others interested in chemical safety: A discussion. In National Safety Congress Transactions: Chemical and Fertilizer Industries. Volume 5. Chicago, IL: National Safety Council. p. 11-12.

NSC (National Safety Council). 1966. Discussion period - What's bugging you? In National Safety Congress Transactions: Labor Safety. Volume 13. Chicago, IL: National Safety Council. p. 38-45.

NSC (National Safety Council). 1967. Safety briefs. Safety News 96 (4):23-23.

NTP (National Toxicology Program). 2011. Report on Carcinogens. Twelfth Edition. Cincinnati, OH: U.S. Department of Health and Human Services. Public Health Service. National Toxicology Program.

Nuwer, R. 2014. Byzantine Monks Built Walls With Asbestos, Too [cited April 15, 2014]. Available from http://www.smithsonianmag.com/smart-news/asbestos-first-gained-popularity-among-byzantine-monks-constructing-wall-paintings-180950365/?no-ist.

OEHC (Occupational and Environmental Health Consultants). 1991. Various studies during asbestos removal at Louisville Gas and Electric. Louisville, KY: Occupational and Environmental Health Consultants.

Oehlert, G. W., R. J. Lee, and D. Van Orden. 1995. Statistical analysis of asbestos fibre counts. Environmetrics 6 (2):115-26.

Oestenstad, K., Y. Honda, E. Delzell, and I. Brill. 2002. Assessment of historical exposures to talc at a mining and milling facility. Ann Occup Hyg 46 (7):587-96.

Ohlson, C. G., and C. Hogstedt. 1985. Lung cancer among asbestos cement workers. A Swedish cohort study and a review. Br J Ind Med 42 (6):397-402.

Ohlson, C. G., B. Klaesson, and C. Hogstedt. 1984. Mortality among asbestos-exposed workers in a railroad workshop. Scandinavian Journal of Work, Environment and Health 10 (5):283-91.

Oksa, P., E. Pukkala, A. Karjalainen, A. Ojajarvi, and M. S. Huuskonen. 1997. Cancer incidence and mortality among Finnish asbestos sprayers and in asbestosis and silicosis patients. American Journal of Industrial Medicine 31 (6):693-8.

Olishifski, J. B., and F. E. McElroy. 1971. Fundamentals of Industrial Hygiene. Chicago, IL: National Safety Council.

Oliver, T. 1914. Lead Poisoning: From the Industrial, Medical, and Social Points of View. New York, NY: PB Hoeber.

Oliver, T. 1927. Clinical Aspects of Pulmonary Asbestosis. Br Med J 2 (3491):1026-7.

Oregon State Board of Health. 1945. Rules and regulations for the prevention and control of occupational diseases. Portland, OR: Oregon State Board of Health.

Osborn, S. H. 1934. Forty-Ninth Report (57th Year) of the State Department of Health, For the Year Ended June 30, 1934. State of Connecticut Public Document No. 25. Hartford, CT: State Department of Health.

OSHA (Occupational Safety and Health Administration). 1971a. Title 29--Labor, Chapter XVIII, Part 1910--Occupational safety and health standards, emergency standard for exposure to asbestos dust. 36 FR 23207-23208. Washington, D.C.: US Department of Labor-Occupational Safety and Health Administration (OSHA). December 7, 1971.

OSHA (Occupational Safety and Health Administration). 1971b. Title 29, Chapter 17, Part 1910: Occupational safety and health standards, national consensus standards and established federal standards (Introduction, Subparts A and B, and portion of Subpart G). Fed. Reg. 36: 10466-10469, 10503-10506. May 29, 1971.

OSHA (Occupational Safety and Health Administration). 1972. Title 29--Labor, Chapter XVII, Part 1910--Occupational safety and health standards, standard for exposure to asbestos dust. Fed. Reg. 37: 11318-11322. June 7, 1972.

OSHA (Occupational Safety and Health Administration). 1974. Field Information Memorandum #74-92 to OSHA Assistant Regional Directors and Area Directors from Barry J. White. U.S. Department of Labor, Occupational Safety and Health Administration. November 21, 1974.

OSHA (Occupational Safety and Health Administration). 1975. 29 CFR Part 1910: Occupational exposure to asbestos, notice of proposed rulemaking. Fed. Reg. 40 (197): 47652-47665. October 9, 1975.

OSHA (Occupational Safety and Health Administration). 1983a. 29 CFR Part 1910: Hazard Communication. Final Rule. Fed. Reg. 48(228): 53280-53348. November 25, 1983.

OSHA (Occupational Safety and Health Administration). 1983b. Occupational exposure to asbestos, Emergency temporary standard. 48 FR 51086-51140. November 4, 1983.

OSHA (Occupational Safety and Health Administration). 1983c. Quantitative Risk Assessment for Asbestos Related Cancers. Revised, October 1983. Washington, D.C.: U.S. Department of Labor, Occupational Safety and Health Administration (OSHA).

OSHA (Occupational Safety and Health Administration). 1986a. 29 CFR Parts 1910 and 1926: Occupational exposure to asbestos, tremolite, anthophyllite, and actinolite; Final rules. Fed. Reg. 51: 22612-22790. June 20, 1986.

OSHA (Occupational Safety and Health Administration). 1986b. Final Regulatory Impact and Regulatory Flexibility Analysis of the Revised Asbestos Standard. Report No. PB-86-221827/XAB. Washington, D.C.: Occupational Safety and Health Administration.

OSHA (Occupational Safety and Health Administration). 1986c. Instruction: Sample Material Data Sheet. OSHA Directive CPL 02-02-039. March 27, 1986. Washington, D.C.: Occupational Safety and Health Administration.

OSHA (Occupational Safety and Health Administration). 1987. 29 CFR1910.1200: Hazard Communication. Fed. Reg. 52: 31852-31886. August 24, 1987.

OSHA (Occupational Safety and Health Administration). 1988a. 29 CFR Parts 1910 and 1926: Occupational exposure to asbestos, tremolite, anthophyllite, and actinolite; Final rules; Amendment. 53 FR 35609. September 14, 1988.

OSHA (Occupational Safety and Health Administration). 1988b. Employers are Responsible for Training New Employees on the HCS. OSHA Standard Interpretation. May 11, 1988. Washington, D.C.: Occupational Safety and Health Administration.

OSHA (Occupational Safety and Health Administration). 1988c. Material Safety Data Sheet Requirements Under the Hazard Communication Standard. OSHA Standard Interpretation. May 12, 1988. Washington, D.C.: Occupational Safety and Health Administration.

OSHA (Occupational Safety and Health Administration). 1989. Distributor’s and Retailer’s Responsibilities for Providing MSDSs. OSHA Standard Interpretation. March 3, 1989. Washington, D.C.: Occupational Safety and Health Administration.

OSHA (Occupational Safety and Health Administration). 1990. 29 CFR Parts 1910 and 1926: Occupational exposure to asbestos, tremolite, anthophyllite and actinolite; Proposed rule. Fed. Reg. 55(140):29712-29753. July 20, 1990.

OSHA (Occupational Safety and Health Administration). 1990. Hazard Communication Standard. OSHA Standard Interpretation. January 22, 1990. Washington, D.C.: Occupational Safety and Health Administration.

OSHA (Occupational Safety and Health Administration). 1991. Standard Interpretation. August 15, 1991. Decision or Policy Statement Regarding the Obligations and Responsibilities of the Employee Leasing Industry with Respect to Compliance with the Occupational Safety and Health Act.[1910.1200; 1910.1030; 1910.178(l)]. Accessed April 10, 2014: https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=20362.

OSHA (Occupational Safety and Health Administration). 1992a. 29 CFR Parts 1910 and 1926: Occupational exposure to asbestos, tremolite, anthophyllite, and actinolite; Final rule. Fed. Reg. 57: 24310-24331. June 8, 1992.

OSHA (Occupational Safety and Health Administration). 1992b. Parts 1910 and 1915-Amended. Fed. Reg. 57(178):42388-42389. September 14,1992.

OSHA (Occupational Safety and Health Administration). 1993a. 29 CFR Part 1910. RIN 1218-AB26. Air Contaminants. Final Rule. Fed Reg 58 (124): 35335-35351. June 30, 1993.

OSHA (Occupational Safety and Health Administration). 1993b. Meeting labeling requirements of hazard communication standard for slag wool. OSHA Standard Interpretation. April 1, 1993. Washington, D.C.: Occupational Safety and Health Administration.

OSHA (Occupational Safety and Health Administration). 1994a. 29 CFR Parts 1910, 1915, and 1926. RIN: 1218-AB25. Occupational exposure to asbestos; Final rule. Fed. Reg. 59:40964-41162. August 10, 1994.

OSHA (Occupational Safety and Health Administration). 1994b. Occupational Safety and Health Standards: Hazard Communication, 29 CFR 1910.1200. Washington, D.C.: Un. March 20, 2010. Accessed March 20, 2011: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10099.

OSHA (Occupational Safety and Health Administration). 1995. OSHA's Hazard Communication Standard. OSHA Standard Interpretation. November 27, 1995. Washington, D.C.: Occupational Safety and Health Administration.

OSHA (Occupational Safety and Health Administration). 1997. Method ID-160: Asbestos in Air. Washington, D.C.: U.S. Department of Labor, Occupational Safety and Health Administration.

OSHA (Occupational Safety and Health Administration). 1998a. Chemical Hazard Communication. OSHA 3084. Washington, D.C.: U.S. Department of Labor, Occupational Safety & Health Administration.

OSHA (Occupational Safety and Health Administration). 1998b. Inspection Procedures for the Hazard Communication Program. OSHA CPL 02-02.038. Washington, D.C.: U.S. Dept. Labor, Occupational Safety and Health Administration.

OSHA (Occupational Safety and Health Administration). 1998c. Training Requirements in OSHA Standards and Training Guidelines. OSHA 2254. Washington, D.C.: U.S. Department of Labor, Occupational Safety & Health Administration.
OSHA (Occupational Safety and Health Administration). 2000. Hazard Communication Guidelines for Compliance. OSHA 3111. Washington, D.C.: Occupational Safety and Health Administration.
OSHA (Occupational Safety and Health Administration). 2002. Title 41--Labor, Chapter L, Part 50-201--General Regulations, The Walsh-Healey Public Contracts Act. July 1, 2002. Washington, D.C.: U.S. Department of Labor, Occupational Safety and Health Administration.
OSHA (Occupational Safety and Health Administration). 2003a. Current OSHA initiatives to improve quality of chemical hazard information provided to workers. Standard Number 1910.1200. Accessed on March 20, 2014: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=24603.
OSHA (Occupational Safety and Health Administration). 2003b. Hazard Communication Standard. OSHA 3186-06N; Model Plans and Programs for the OSHA Bloodborne Pathogens and Hazard Communications Standards. Washington, D.C.: Occupational Safety and Health Administration.
OSHA (Occupational Safety and Health Administration). 2004a. Recommended Format for Material Safety Data Sheets (MSDSs). Accessed on July 22, 2004: http://www.osha.gov/dsg/hazcom/msdsformat.html.
OSHA (Occupational Safety and Health Administration). 2004b. SEC. 18. State Jurisdiction and State Plans. OSHA Act of 1970 as amended through January 1, 2004. Washington, D.C.: U.S. Department of Labor, Occupational Safety and Health Administration.
OSHA (Occupational Safety and Health Administration). 2006a. Advance Notice of Proposed Rulemaking (ANPRM); Hazard Communication Standard. Federal Register 71:53617-53627. September 12, 2006.
OSHA (Occupational Safety and Health Administration). 2006b. Interlinked Information on State Plan Standards and Policies/Directives. Washington, D.C.: U.S. Department of Labor, Occupational Safety and Health Administration.
OSHA (Occupational Safety and Health Administration). 2006c. Table Z-3 Mineral Dusts. U.S. Department of Labor, Occupational Safety and Health Administration [cited March 28, 2013]. Available from http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9994.

OSHA (Occupational Safety and Health Administration). 2007. Use of Generic MSDSs Written by Third-Party Companies and Employer Responsibilities when Using an Online MSDS Service. OSHA Standard Interpretation. March 7, 2007. Washington, D.C.: U.S. Department of Labor, Occupational Safety and Health Administration.

OSHA (Occupational Safety and Health Administration). 2009. The Globally Harmonized System for Hazard Communication. Washington, D.C.: U.S. Department of Labor, Occupational Safety and Health Administration.

OSHA (Occupational Safety and Health Administration). 2014a. 29 CFR Parts 1910, 1915, 1917, et al. Chemical Management and Permissible Exposure Limits (PELs); Proposed Rule. Federal Register Vol. 79, No. 197. p. 61383-61438. October 10, 2014.

OSHA (Occupational Safety and Health Administration). 2014b. Safety and Health Topics. Asbestos. Washington, D.C.: Occupational Safety and Health Administration. Available at: https://www.osha.gov/SLTC/asbestos/.

OSHA (Occupational Safety and Health Administration). Date Unknown. GHS - OSHA HCS Comparison of Hazard Communication Requirements. Available at: http://www.osha.gov/dsg/hazcom/docs/GHSOSHAComparison.pdf. Washington, D.C.: Occupational Safety and Health Administration.

Ozonoff, D. 1988. Failed warnings: Asbestos-related disease and industrial medicine. In The Health and Safety of Workers. Case Studies in the Politics of Professional Responsibility, edited by R. Bayer. New York: Oxford University Press. p. 139-220.

Pabst, A. C. 1955. The expanding field of industrial hygiene. In National Safety News. Chicago, IL: National Safety Council. p. 20-21, 103-111.

Page, R. C. 1935. A study of the sputum in pulmonary asbestosis. Am J Med Sci 189:44-55.

Pancoast, H. K., and E. P. Pendergrass. 1925. A review of our present knowledge of pneumoconiosis, based upon roentgenologic studies, with notes on the pathology of the condition. Am J Roentgenol 24 (5):381-423.

Pang, T. W. S., F. A. Schonfeld, and M. A. Nazar. 1987. The determination of tremolite asbestos in talc powder samples. Annals of Occupational Hygiene 31 (2):219-225.

Parent, A. 2004. Giovanni Aldini: from animal electricity to human brain stimulation. Can J Neurol Sci 31 (4):576-84.

Patty, F. A. 1948. Patty's Industrial Hygiene and Toxicology. First edition. New York: Interscience Publishers, Inc.

Patty, F. A. 1958. Industrial Hygiene-Retrospect and Prospect. In Patty's Industrial Hygiene and Toxicology, edited by F. A. Patty. New York: Interscience Publishers, Inc. p. 1-18.

Patty, F. A., and F. R. Holden. 1949. Potential exposures in industry: Their recognition and control. In Patty's Industrial Hygiene and Toxicology, edited by F. A. Patty. New York: Interscience Publishers, Inc. p. 1049-1114.

Paustenbach, D. 1989. The Risk Assessment of Environmental Hazards: A Textbook of Case Studies. New York, NY: John Wiley & Sons.

Paustenbach, D. 2002. Human and Ecological Risk Assessment: Theory and Practice. New York, NY: John Wiley & Sons.

Paustenbach, D. J., A. K. Madl, E. Donovan, K. Clark, K. Fehling, and T. C. Lee. 2006. Chrysotile asbestos exposure associated with removal of automobile exhaust systems (ca. 1945-1975) by mechanics: results of a simulation study. J Expo Sci Environ Epidemiol 16 (2):156-71.

Paustenbach, D. J., A. Sage, M. Bono, and F. Mowat. 2004. Occupational exposure to airborne asbestos from coatings, mastics, and adhesives. Journal of Exposure Analysis and Environmental Epidemiology 14 (3):234-44.

Paustenbach, D. J., B. L. Finley, E. T. Lu, G. P. Brorby, and P. J. Sheehan. 2004. Environmental and occupational health hazards associated with the presence of asbestos in brake linings and pads (1900 to present): A "state-of-the-art" review. Journal of Toxicology and Environmental Health, Part B 7 (1):25-80.

Paustenbach, D. J., D. Cowan, and J. Sahmel. 2011. The history and biological basis of occupational exposure limits for chemical agents. In Patty's Industrial Hygiene, edited by V. E. Rose and B. Cohrssen. Hoboken, NJ: John Wiley & Sons, Inc. p. 865-956.

Paustenbach, D. J., J. S. Knutsen, D. M. Hollins, J. E. Sahmel, and A. K. Madl. 2010. Comparison of modeled and measured concentrations of airborne benzene from the use of petroleum-based solvents spiked with low levels of benzene. Chem Biol Interact 184 (1-2):296-8.

Paustenbach, D. J., R. O. Richter, B. L. Finley, and P. J. Sheehan. 2003. An evaluation of the historical exposures of mechanics to asbestos in brake dust. Appl Occup Environ Hyg 18 (10):786-804.

Paustenbach, D., and A. Madl. 2008. The practice of exposure assessment. In Principles and Methods of Toxicology, edited by A. W. Hayes. Andover, MA: CRC Press. p. 475-534.

Perkins, J. 2008. Modern Industrial Hygiene, Volume I: Recognition and Evaluation of Chemical Agents. Second edition. Cincinnati, OH: American Conference of Governmental Industrial Hygienists (ACGIH).

Peterson, J. E. 1977. Industrial Health. Englewood Cliffs, NJ: Prentice-Hall.

Peto, J. 1980. Lung cancer mortality in relation to measured dust levels in an asbestos textile factory. IARC Sci Publ (30):829-36.

Peto, J., H. Seidman, and I. J. Selikoff. 1982. Mesothelioma mortality in asbestos workers: implications for models of carcinogenesis and risk assessment. Br J Cancer 45 (1):124-35.

Pettigrew, G. L., and H. L. J. Markel. 1984. HETA 84-028-1517. Drive Train Industries, Inc., Albuquerque, New Mexico. October 1984. Cincinnati, OH: Hazard Evaluations and Technical Assistance Branch, National Institute of Occupational Safety and Health.

Phelka, A. D., and B. L. Finley. 2012. Potential health hazards associated with exposures to asbestos-containing drywall accessory products: A state-of-the-science assessment. Crit Rev Toxicol 42 (1):1-27.

Pira, E., C. Pelucchi, P. G. Piolatto, E. Negri, T. Bilei, and C. La Vecchia. 2009. Mortality from cancer and other causes in the Balangero cohort of chrysotile asbestos miners. Occup Environ Med 66 (12):805-9.

Platek, S. F., D. H. Groth, C. E. Ulrich, L. E. Stettler, M. S. Finnell, and M. Stoll. 1985. Chronic inhalation of short asbestos fibers. Fundam Appl Toxicol 5 (2):327-40.

Plato, N., G. Tornling, C. Hogstedt, and S. Krantz. 1995. An index of past asbestos exposure as applied to car and bus mechanics. Ann Occup Hyg 39 (4):441-54.

Price, B., and A. Ware. 2004. Mesothelioma trends in the United States: an update based on Surveillance, Epidemiology, and End Results Program data for 1973 through 2003. Am J Epidemiol 159 (2):107-12.

Price, B., and A. Ware. 2005. Mesothelioma: risk apportionment among asbestos exposure sources. Risk Anal 25 (4):937-43.

Price, B., and A. Ware. 2009. Time trend of mesothelioma incidence in the United States and projection of future cases: an update based on SEER data for 1973 through 2005. Crit Rev Toxicol 39 (7):576-88.

Pryor, P. 1982. HETA 82-270-1238. Drive Train Industries, Inc. Denver, Colorado. December 1982. Cincinnati, OH: Hazard Evaluations and Technical Assistance Branch, National Institute of Occupational Safety and Health.

Pryor, P., and B. J. Gunter. 1983. HETA 83-039-1305. Drive Train Industries, Inc., Grand Junction, Colorado. May 1983. Cincinnati, OH: Hazard Evaluations and Technical Assistance Branch, National Institute of Occupational Safety and Health.

Pukkala, E., J. I. Martinsen, E. Lynge, H. K. Gunnarsdottir, P. Sparen, L. Tryggvadottir, E. Weiderpass, and K. Kjaerheim. 2009. Occupation and cancer - follow-up of 15 million people in five Nordic countries. Acta Oncol 48 (5):646-790.

Radford, E. P. 1976. Cancer mortality in the steel industry. Ann N Y Acad Sci 271:228-38.

Rake, C., C. Gilham, J. Hatch, A. Darnton, J. Hodgson, and J. Peto. 2009. Occupational, domestic and environmental mesothelioma risks in the British population: a case-control study. Br J Cancer 100 (7):1175-83.

Redmond, C. K., A. Ciocco, J. W. Lloyd, and H. W. Rush. 1972. Long-term mortality study of steelworkers. VI. Mortality from malignant neoplasms among coke oven workers. J Occup Med 14 (8):621-9.

Redmond, C. K., E. M. Smith, J. W. Lloyd, and H. W. Rush. 1969. Long-term mortality study of steelworkers. III. Follow-up. Journal of Occupational Medicine 11 (10):513-21.

Redmond, C. K., H. S. Wieand, H. E. Rockette, R. Sass, and G. Weinberg. 1981. Long-Term Mortality Experience of Steelworkers. DHHS (NIOSH) Publication: No. 81-120. June 1981. Cincinnati, Ohio: U.S. Dept. of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Division of Surveillance, Hazard Evaluations and Field Studies.

Redmond, C. K., J. Gustin, and E. Kamon. 1975. Long-term mortality experience of steelworkers. VIII. Mortality patterns of open hearth steelworkers (a preliminary report). Journal of Occupational Medicine 17 (1):40-3.

Reid, A., J. Heyworth, N. de Klerk, and A. W. Musk. 2008. The mortality of women exposed environmentally and domestically to blue asbestos at Wittenoom, Western Australia. Occup Environ Med 65 (11):743-9.

Reid, A., J. Heyworth, N. H. de Klerk, and B. Musk. 2008. Cancer incidence among women and girls environmentally and occupationally exposed to blue asbestos at Wittenoom, Western Australia. Int J Cancer 122 (10):2337-44.

Reid, A., P. Franklin, G. Berry, S. Peters, N. Sodhi-Berry, F. Brims, A. W. Musk, and N. H. de Klerk. 2018. Are children more vulnerable to mesothelioma than adults? A comparison of mesothelioma risk among children and adults exposed non-occupationally to blue asbestos at Wittenoom. Occup Environ Med 75 (12):898-903.

Reist, P. C. 1984. Introduction to Aerosol Science. New York, NY: MacMillan.

Reitze, W. B., W. J. Nicholson, D. A. Holaday, and I. J. Selikoff. 1972. Application of sprayed inorganic fiber containing asbestos: Occupational health hazards. American Industrial Hygiene Association Journal 33 (3):178-91.

Renshaw, F. M., J. M. Bachman, and J. O. Pierce. 1969. The Use of Midget Impingers and Membrane Filters for Determining Particle Counts. AIHAJ (March-April):113-116.

Rhodes, H. B., and B. L. Ingalls. 1975. Asbestos and silica dust in the drywall industry, Part I. Gypsum Drywall Contractors International. Drywall 21:6-8, 30.

Rhodes, H. B., and B. L. Ingalls. 1976. Asbestos and silica dust in the drywall industry, Part II. Gypsum Drywall Contractors International. Drywall 22:8-11, 30-31.

Rhodes, H. B., and G. J. Spencer. 1977. Airborne Fiber Counts in a Consumer Spackling and Drywall Replacement Installation Project. Date Sampled: June 21-25, 1977. Date Reported: July 12, 1977. Niagara Falls, NY: Union Carbide Corporation, Metals Division.

Ribleit, W. R. 1968. Department of the Navy Memo from SEC 6100 to SHIPS 07 Re: "Hazards of Asbestos," with enclosures, December 9, 1968.

Richter, R. O., B. L. Finley, D. J. Paustenbach, P. R. Williams, and P. J. Sheehan. 2009. An evaluation of short-term exposures of brake mechanics to asbestos during automotive and truck brake cleaning and machining activities. J Expo Sci Environ Epidemiol 19 (5):458-74.

RJ Lee Group Inc. 2004. Observations During Inspection of Manual Transmissions. Project: LSH307891. July 2004. Monroeville, PA: RJ Lee Group Inc.

Roach, S. A. 1970. Hygiene standards for asbestos. Ann Occup Hyg 13 (1):7-15.

Roberts, D. R. 1980a. Industrial Hygiene Report: Asbestos: Allied Brake Shop, Cincinnati, Ohio. June 30, 1980. Cincinnati, Ohio: Industrial Health Section, Division of Surveillance, Hazard Occupations, and Field Studies, National Institute of Occupational Safety and Health.

Roberts, D. R. 1980b. Industrial Hygiene Report: Asbestos: Reading Brake and Alignment Service, Reading, Ohio. March 1980. Cincinnati, OH: Industrial Hygiene Section, Industry-wide Studies Branch, Division of Surveillance, Hazard Occupations, and Field Studies, National Institute for Occupational Safety and Health (NIOSH).

Roberts, D. R., and R. D. Zumwalde. 1980. Industrial Hygiene Survey Report of the New York City Sanitation, Traffic, and Police Brake Servicing Facilities, Queens, New York. May 12, 1980. Cincinnati, OH: Industrial Hygiene Section, Industry-wide Studies Branch, Division of Surveillance, Hazard Occupations, and Field Studies, National Institute for Occupational Safety and Health.

Roberts, D. R., and R. D. Zumwalde. 1982. Industrial Hygiene Summary Report of Asbestos Exposure Assessment for Brake Mechanics. Report #32.4. November 22, 1982. Cincinnati, OH: Industrial Hygiene Section, Industry-wide Studies Branch, Division of Surveillance, Hazard Occupations, and Field Studies, National Institute of Occupation Safety and Health.

Robin, E. D., and R. P. O'Neill. 1963. The pneumoconioses. Diagnosis, evaluation, and management. Archives of Environmental Health 7:130-71.

Robinson, H. 1969. Long-term mortality study of steelworkers. II. Mortality by level of income in whites and non-whites. Journal of Occupational Medicine 11 (8):411-6.

Rockette, H. E., and C. K. Redmond. 1976. Long-term mortality study of steelworkers. X. Mortality patterns among masons. Journal of Occupational Medicine 18 (8):541-5.

Rodelsperger, K., H. Jahn, B. Bruckel, J. Manke, R. Paur, and H. J. Woitowitz. 1986. Asbestos dust exposure during brake repair. Am J Ind Med 10 (1):63-72.

Roggli, V., and T. D. Oury. 2004. Pathology of Asbestos Associated Diseases. Second edition. New York, NY: Springer-Verlag New York, Inc.

Rohl, A. N., A. M. Langer, I. J. Selikoff, and W. J. Nicholson. 1975. Exposure to asbestos in the use of consumer spackling, patching, and taping compounds. Science 189 (4202):551-3.

Rohl, A. N., A. M. Langer, M. S. Wolff, and I. Weisman. 1976. Asbestos exposure during brake lining maintenance and repair. Environ Res 12 (1):110-28.

Rohl, A. N., A. M. Langer, R. Klimentidis, M. S. Wolff, and I. J. Selikoff. 1977. Asbestos content of dust encountered in brake maintenance and repair. Proc R Soc Med 70 (1):32-7.

Rom, W., A. Miller, H. Anderson, and I. J. Selikoff. 1976. Changes in pulmonary function in household contacts of asbestos workers. Am Rev Respir Dis 113 (4):88.

Ross, M., and R. P. Nolan. 2003. History of asbestos discovery and use and asbestos-related disease in context with the occurrence of asbestos within ophiolite complexes. Geological Society of America, Special Paper 373:447-470.

Rossiter, A. S. 1935. The history of the asbestos manufacturing industry. Asbestos 17 (4):6-14.

Rothstein, M. A. 1998. Part II Duties Under the Act, Chapter 5 Compliance with Standards. In West's Handbook Series: Occupational Safety and Health Law, Fourth Edition. St. Paul, MN: West Group.

Rowson, D. M. 1978. The chrysotile content of wear debris of brake linings. Wear 47 (2):315-321.

Rubino, G. F., G. Scansetti, A. Donna, and G. Palestro. 1972. Epidemiology of pleural mesothelioma in North-western Italy (Piedmont). Br J Ind Med 29 (4):436-42.

Rubino, G. F., G. Scansetti, G. Piolatto, and C. A. Romano. 1976. Mortality study of talc miners and millers. J Occup Med 18:186-193.

Ruhe, R. L., and J. C. Lipscomb. 1985. Health Hazard Evaluation Report (HETA) 84-151-1544, Nuturn Corporation, New Castle, Indiana. April 1985. Cincinnati, OH: National Institute for Occupational Safety and Health, Hazard Evaluations and Technical Assistance Branch.

Rusby, N. L. 1968. Pleural manifestations following the inhalation of asbestos in relation to malignant change. J Royal Naval Med Serv LIV 2:142-148.

Rushworth, D. H. 2005. The Navy and asbestos thermal insulation. Naval Engineers Journal Spring 2005:35-48.

Russell, R. S., R. D. Merz, W. T. Sherman, and J. N. Sivertson. 1979. The determination of respirable particles in talcum powder. Food Cosmet Toxicol 17 (2):117-22.

Sahmel, J., and M. Boeniger. 2006. Dermal exposure assessments. In A Strategy for Assessing and Managing Occupational Exposure, Third Edition, edited by J. Ignacio and W. Bullock. Fairfax, VA: American Industrial Hygiene Association Press. p. 137-161.

Sahmel, J., and M. Boeniger. 2015. Dermal exposure assessments. In A Strategy for Assessing and Managing Occupational Exposures. 4th Edition, edited by S. D. Jahn, W. H. Bullock and J. S. Ignacio. Fairfax, VA: AIHA. p. 171-195.

Sahmel, J., C. A. Barlow, B. Simmons, S. H. Gaffney, H. J. Avens, A. K. Madl, J. Henshaw, R. J. Lee, D. Van Orden, M. Sanchez, M. Zock, and D. J. Paustenbach. 2014. Evaluation of take-home exposure and risk associated with the handling of clothing contaminated with chrysotile asbestos. Risk Analysis 34 (8):1448-68.

Sahmel, J., C. A. Barlow, S. Gaffney, H. J. Avens, A. K. Madl, J. Henshaw, K. Unice, D. Galbraith, G. DeRose, R. J. Lee, D. Van Orden, M. Sanchez, M. Zock, and D. J. Paustenbach. 2016. Airborne asbestos take-home exposures during handling of chrysotile-contaminated clothing following simulated full shift workplace exposures. Journal of Exposure Science and Environmental Epidemiology 26:48-62.

Sahmel, J., E. I. Hsu, H. J. Avens, E. M. Beckett, and K. D. Devlin. 2015. Estimation of hand-to-mouth transfer efficiency of lead. Annals of Occupational Hygiene 59 (2):210-20.

Sahmel, J., H. J. Avens, P. K. Scott, K. Unice, A. Burns, C. A. Barlow, A. K. Madl, J. Henshaw, and D. J. Paustenbach. 2015. Measured removal rates of chrysotile asbestos fibers from air and comparison with theoretical estimates based on gravitational settling and dilution ventilation. Inhalation Toxicology 27 (14):787-801.

Sahmel, J., K. Devlin, D. Paustenbach, D. Hollins, and S. Gaffney. 2010. The role of exposure reconstruction in occupational human health risk assessment: current methods and a recommended framework. Crit Rev Toxicol 40 (9):799-843.

Sahmel, J., K. Unice, P. Scott, D. Cowan, and D. Paustenbach. 2009. The use of multizone models to estimate an airborne chemical contaminant generation and decay profile: Occupational exposures of hairdressers to vinyl chloride in hairspray during the 1960s and 1970s. Risk Analysis 29 (12):1699-725.

Sahmel, J., M. Boeniger, and C. Fehrenbacher. 2006. Appendix II: Dermal exposure assessment methods. In A Strategy for Assessing and Managing Occupational Exposure, Third Edition, edited by J. Ignacio and W. Bullock. Fairfax, VA: American Industrial Hygiene Association Press. p. 305-333.

Sahmel, J., M. Boeniger, J. Knutsen, W. ten Berge, and M. C. Fehrenbacher. 2009. Dermal Exposure Modeling. In Mathematical Models for Estimating Occupational Exposure, 2nd Edition, edited by C. B. Keil, C. E. Simmons and T. R. Anthony. Fairfax, VA: American Industrial Hygiene Association Press. p. 105-132.

Sahmel, J., S. Gaffney, J. Knutsen, B. Epstien, and D. Paustenbach. 2014. Determinants of carbon monoxide exposure inside a motor home during on-board generator use. International Journal of Vehicle Safety 7 (3-4):409-424.

Sakai, K., N. Hisanaga, E. Shibata, Y. Ono, and Y. Takeuchi. 2006. Asbestos exposures during reprocessing of automobile brakes and clutches. Int J Occup Environ Health 12 (2):95-105.

Salazar, N., M. F. Cely-Garcia, P. N. Breysse, and J. P. Ramos-Bonilla. 2015. Asbestos exposure among transmission mechanics in automotive repair shops. Annals of Occupational Hygiene 59 (3):292-306.

Sanden, A., B. Jarvholm, S. Larsson, and G. Thiringer. 1992. The risk of lung cancer and mesothelioma after cessation of asbestos exposure: A prospective cohort study of shipyard workers. European Respiratory Journal 5 (3):281-5.

Sander, O. A. 1958. The Pulmonary Dust Diseases. In Industrial Hygiene and Toxicology, Second Revised Edition, Volume I, General Principles, edited by F. A. Patty. New York: Interscience Publishers Inc., John Wiley & Sons. p. 357-411.

Sandland, G. W. 1976. Talc. CFTA Cosmetic Journal 8 (1):21-22.

Sappington, C. O. 1932. Are All Dusts Hazardous? National Safety News 25 (2):18-20.

Sawyer, R. N. 1977. Asbestos exposure in a Yale building. Analysis and resolution. Environ Res 13 (1):146-69.

Sawyer, R. N., and C. M. Spooner. 1978. Sprayed Asbestos-Containing Material in Buildings. A Guidance Document. Part 2. Research Triangle Park, NC: United States Environmental Protection Agency.

Sayers, R. R. 1937. Industrial Dusts: What Industrial Dusts are Harmful? Why? In Transactions, 26th National Safety Congress, October 11-15, 1937. Kansas City, MO: National Safety Council, p. 85-92.

Sayers, R. R. 1938. Dusts That Harm: A descriptive summary of common industrial dusts according to physical characteristics and physiological effects. National Safety News 37 (1):51-52, 82-84.

Sayers, R. R., and A. J. Lanza. 1938. Etiology, Symptoms, Diagnosis of Silicosis and Asbestosis. In Silicosis and Asbestosis, edited by A. J. Lanza. London: Oxford University Press. p. 31-65.

Schaffner, R. M. 1976. Memo from Robert M. Schaffner, Ph.D. (Food and Drug Administration) to Acting Director, Bureau of Foods, RE: Asbestos in Talc - Proposed Regulation. Dated March 19, 1976.

Schall, E. L. 1965. Present threshold limit value in the U.S.A. for asbestos dust: A critique. Ann N Y Acad Sci 132 (1):316-21.

Seidman, H. 1984. Short-term asbestos work exposure and long-term observation--July 1984 updating. In Docket of current rulemaking for revision of the asbestos (dust) standard, Docket No. H033C. Washington, D.C.: US Department of Labor, Occupational Safety and Health Administration.

Seidman, H., and I. J. Selikoff. 1990. Decline in death rates among asbestos insulation workers 1967-1986 associated with diminution of work exposure to asbestos. Ann N Y Acad Sci 609:300-17; discussion 317-8.

Seidman, H., I. J. Selikoff, and E. C. Hammond. 1979. Short-term asbestos work exposure and long-term observation. Ann N Y Acad Sci 330:61-89.

Seiler, H. E. 1928. A Case of Pneumoconiosis: Result of the Inhalation of Asbestos Dust. Br Med J 2 (3543):981-982.

Selikoff, I. 1965a. Opening Remarks. Ann NY Acad Sci 132:7-8.

Selikoff, I. J. 1965b. The occurrence of pleural calcification among asbestos insulation workers. Ann NY Acad Sci 132 (1):351-67.

Selikoff, I. J. 1969. Industrial Hygiene Progress Reports. Spring 1969. Volume 1, Issue 1.

Selikoff, I. J. 1970. Partnership for prevention--the insulation industry hygiene research program. IMS, Industrial Medicine and Surgery 39 (4):162-6.

Selikoff, I. J. 1970a. Partnership for prevention--the insulation industry hygiene research program. IMS, Industrial Medicine and Surgery 39 (4):162-6.

Selikoff, I. J. 1970b. The U.S. Navy Joins Battle with Shipyard Dust. Insulation Hygiene Progress Reports: From the Insulation Industry Hygiene Research Program. Environmental Sciences Laboratory, Mount Sinai School of Medicine, New York. Winter 2(4):1-4.

Selikoff, I. J. 1974. Asbestos Criteria Document Highlights. American Society of Safety Engineers Journal 19 (3):26-33.

Selikoff, I. J., and D. H. K. Lee. 1978a. Asbestos and Disease. Edited by D. H. K. Lee, W. Hewson and D. Okun. New York: Academic Press.

Selikoff, I. J., and D. H. K. Lee. 1978b. Table 1-3. In Asbestos and Disease. New York, NY: Academic Press. p. 18-18.

Selikoff, I. J., E. C. Hammond, and H. Seidman. 1979. Mortality experience of insulation workers in the United States and Canada, 1943--1976. Ann N Y Acad Sci 330:91-116.

Selikoff, I. J., E. C. Hammond, and J. Churg. 1972. Carcinogenicity of amosite asbestos. Arch Environ Health 25 (3):183-6.

Selikoff, I. J., J. Churg, and E. C. Hammond. 1964. Asbestos exposure and neoplasia. JAMA 188:22-6.

Selikoff, I. J., J. Churg, and E. C. Hammond. 1965a. The occurrence of asbestosis among insulation workers in the United States. Annals of the New York Academy of Sciences 132 (1):139-55.

Selikoff, I. J., J. Churg, and E. C. Hammond. 1965b. Relation between exposure to asbestos and mesothelioma. N Engl J Med 272:560-5.

Shapiro, H. A. 1970. Pneumoconiosis: Proceedings of the International Conferences, 1969. Johannesburg: Oxford University Press.

Sheehy, J. W., F. W. Godbey, T. C. Cooper, K. L. Lenihan, H. D. Van Wagenen, and J. D. McGlothlin. 1987a. In-Depth Survey Report: Control Technology for Brake Drum Service Operations at Ohio Department of Transportation, Maintenance Facility, Lebanon, Ohio, Report No. ECTB 152-18b 152-18b. February 1987. Cincinnati, OH: National Institute for Occupational Safety and Health, Division of Physical Sciences and Engineering, Engineering Control Technology Branch.

Sheehy, J. W., T. C. Cooper, D. M. O'Brien, J. D. McGlothlin, and P. A. Froehlich. 1989. Control of Asbestos Exposure During Brake Drum Service. DHHS (NIOSH) Publication No. 89-121. August 1989. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Services, Center for Disease Control and Prevention, National Institute for Occupational Safety and Health.

Sheehy, J. W., W. F. Todd, T. C. Cooper, and H. D. Van Wagenen. 1987b. In-Depth Survey Report: Evaluation of Brake Drum Service Controls at Cincinnati Bell, Maintenance Facility, Fairfax, Ohio, Report No. ECTB 152-21b. October 1987. Cincinnati, OH: National Institute for Occupational Safety and Health, Division of Physical Sciences and Engineering, Engineering Control Technology Branch.

Siedlecki, J. T. 1960. Abstracts of the Current Literature on Occupational Hygiene, Medicine, and Nursing. National Safety News 82 (3):62, 131-132.

Siegal, W., A. R. Smith, and L. Greenburg. 1943. The dust hazard in tremolite talc mining, including roentgenological findings in talc workers. American Journal of Roentgenology 49 (1):11-29.

Simson, F. W. 1928. Pulmonary asbestosis in South Africa. Br Med J 1 (3516):885-887.

Smith, K. W. 1949. Memorandum from Kenneth W. Smith to George K. Foster, re: Saranac Report, dated March 19, 1949.

Smith, W. E. 1952. Survey of some current British and European studies of occupational tumor problems. AMA Arch Ind Hyg Occup Med 5 (3):242-63.

Snell, M. A. 1941. Essentials of healthful industrial environment. In Transactions, 30th National Safety Congress, Chicago, October 6-10, 1941, edited by National Safety Council. Chicago, IL: National Safety Council. p. 152-158.

Spence, S. K., and P. S. Rocchi. 1996. Exposure to asbestos fibres during gasket removal. Annals of Occupational Hygiene 40 (5):583-8.

Spencer, J. W. 2002. Report of Findings: Exposure Assessment: An Evaluation of the Actual Contribution of Airborne Asbestos Fibers from the Operation and Brake Maintenance

Activities on an American Crane. EPI Project No. 21115. June 26, 2002. Baltimore, MD: Environmental Profiles Inc.

Spencer, J. W. 2003a. Exposure Assessment: An evaluation of the contribution of airborne asbestos fibers from the operation of Caterpillar equipment in the field. EPI Project No. 22595: Environmental Profiles, Inc.

Spencer, J. W. 2003b. Report of Findings: Exposure Assessment: An Evaluation of the Contribution of Airborne Asbestos Fibers from the Removal and Installation of Brake and Clutch Materials from John Deere Tractors. EPI Project No. 22440. February 28, 2003. Baltimore, MD: Environmental Profiles, Inc.

Stanton, M. F. 1973. Some etiological considerations of fibre carcinogenesis. In Biological Effects of Asbestos: Proceedings of a Working Conference. IARC Scientific Publications No. 8, edited by P. Bogovski, V. Timbrell, J. C. Gilson and J. C. Wagner. Lyon: International Agency for Research on Cancer. p. 289-294.

Stanton, M. F., M. Layard, A. Tegeris, E. Miller, M. May, and E. Kent. 1977. Carcinogenicity of fibrous glass: pleural response in the rat in relation to fiber dimension. J Natl Cancer Inst 58 (3):587-603.

Stanton, M. F., R. Blackwell, and E. Miller. 1969. Experimental pulmonary carcinogenesis with asbestos. Am Ind Hyg Assoc J 30 (3):236-44.

Stayner, L., E. Kuempel, S. Gilbert, M. Hein, and J. Dement. 2008. An epidemiological study of the role of chrysotile asbestos fibre dimensions in determining respiratory disease risk in exposed workers. Occup Environ Med 65 (9):613-9.

Stenographers' Minutes Before the United States Maritime Commission. 1942. Meeting in regard to minimum requirements for industrial health and safety in shipyards. December 7 and 8, 1942, Chicago, Illinois.

Stettler, L. E., D. D. Sharpnack, and E. F. Krieg. 2008. Chronic inhalation of short asbestos: lung fiber burdens and histopathology for monkeys maintained for 11.5 years after exposure. Inhal Toxicol 20 (1):63-73.

Stewart, M. J., and A. C. Haddow. 1929. Demonstration of the peculiar bodies of pulmonary asbestosis ("asbestos bodies") in material obtained by lung puncture and in the sputum. J Pathol Bacteriol 32 (1):172.

Stokinger, H. E. 1955. Standards for Safeguarding the Health of the Industrial Worker. The Medical Bulletin 15 (3):167-184.

Stokinger, H. E. 1956. Methods of establishing threshold limits; prepared discussion. Am Ind Hyg Assoc Q 17 (3):284-6.

Stokinger, H. E. 1973. Memorandum re: "Identification of a threshold of response and estimations of safety factors in the present recommended standards for the industrial

carcinogen, ASBESTOS." Department of Health, Education, and Welfare, Centers for Disease Control, NIOSH. August 8, 1973.

Stokinger, H. E. 1981. Threshold limit values In Dangerous Properties of Industrial Materials, edited by H. E. Stokinger. New York: Van Nostrand Reinhold. p. 8-13.

Stone, M. J. 1940. Clinical studies in asbestosis. Am Rev Tuberc 41:12-21.

Strohmeier, B. R., J. C. Huntington, K. L. Bunker, M. S. Sanchez, K. Allison, and R. J. Lee. 2010. What is asbestos and why is it important? Challenges of defining and characterizing asbestos. International Geology Review 52 (7):801-872.

Summers, A. L. 1919. Asbestos and the asbestos industry. London: Sir Isaac Pitman and Sons.

Sutton, A., and M. Sutton. 1958. Asbestos: Miracle mineral. Science Digest 43:10-14.

Swanson, J. W. 1986. Memo from J.W. Swanson (Acting Associate Commissioner for Regulatory Affairs - U.S. Food and Drug Administration) to Mr. Phillippe Douillet, RE: Docket Number 1982P-404, Denying a November 8, 1983, Petition Requesting that Cosmetic Talc be Labeled with an Asbestos Warning Statement (Includes Enclosures/Talc Documents). Dated July 11, 1986.

Talcott, J. A., W. A. Thurber, A. F. Kantor, E. A. Gaensler, J. F. Danahy, K. H. Antman, and F. P. Li. 1989. Asbestos-associated diseases in a cohort of cigarette-filter workers. New England Journal of Medicine 321 (18):1220-3.

Tarchi, M., D. Orsi, P. Comba, M. De Santis, R. Pirastu, G. Battista, and M. Valiani. 1994. Cohort mortality study of rock salt workers in Italy. American Journal of Industrial Medicine 25 (2):251-6.

Teschke, K., M. S. Morgan, H. Checkoway, G. Franklin, J. J. Spinelli, G. van Belle, and N. S. Weiss. 1997. Mesothelioma surveillance to locate sources of exposure to asbestos. Can J Public Health 88 (3):163-8.

Teta, M. J., P. J. Mink, E. Lau, B. K. Sceurman, and E. D. Foster. 2008. US mesothelioma patterns 1973-2002: indicators of change and insights into background rates. Eur J Cancer Prev 17 (6):525-34.

Teyssier, L., and R. Lesobre. 1968. [Pleural patches of non-occupational asbestosis]. J Fr Med Chir Thorac 22 (7):797-808.

Thomas, D. L. 1957. Pneumonokoniosis in Victorian industry. Med J Aust 44 (3):75-7.

Thomas, H. F., I. T. Benjamin, P. C. Elwood, and P. M. Sweetnam. 1982. Further follow-up study of workers from an asbestos cement factory. Br J Ind Med 39 (3):273-6.

Thornburg, J. and C. Rodes. 2009. Final Report on Resuspension of Fibers from Indoor Surfaces Due to Human Activity. EPA/600/R-09/009. February 2009. Research Triangle Park, N.C, U.S. Environmental Protection Agency. Office of Research and Development, National Homeland Security Research Center.

Timbrell, V. 1965. Human exposure to asbestos: Dust controls and standards. The inhalation of fibrous dusts. Annals of the New York Academy of Sciences 132 (1):255-73.

Tobin, M. J. 1952. Safety and Health Standards for Contractors Performing Federal Supply Contracts Under the Walsh-Healey Public Contracts Act. Washington, D.C.: U.S. GPO.

Tolman, W. H., and L. B. Kendall. 1913. Industrial poisons. In Safety; Methods for Preventing Occupational and Other Accidents and Disease, edited by W. H. Tolman and L. B. Kendall. New York: Harper. p. 245-265.

U.S. Department of Labor Division of Public Contracts Division. 1942. Basic safety and health requirements for establishments subject to Walsh-Healey Public Contracts Act, edited by D. o. P. C. D. U.S. Department of Labor. Washington, D.C.: United States Government Printing Office.

U.S. Navy. 1924. Military Specification: Packing, Sheet, Asbestos-fiber, Compressed. 33P13. October 1, 1924. Washington, D.C.: Department of Specifications.

U.S. Navy. 1943. Minimum requirements for safety and industrial health in contract shipyards. U.S. Navy and the U.S. Maritime Commission. Washington, D.C.: U. S. Navy Department, U.S. Maritime Commission. p. 1-35

U.S. Navy. 1945. Bureau of Ships Manual: Thermal Insulation, Chapter 39. NAVSHIPS 250-0000(39). Washington D.C. NAVSHIPS 250-0000(39). Washington, D.C.: U.S. Navy, Bureau of Ships. p. 1-35.

U.S. Navy. 1946. Bureau of Ships Manual: Thermal Insulation, Chapter 39. NAVSHIPS 250-0000(39). Washington, D.C.: U.S. Navy, Bureau of Ships.

U.S. Navy. 1947. Bureau of Ships Manual: Chapter 39: Thermal Insulation. Washington, D.C.: U.S. Navy, Bureau of Ships.

U.S. Navy. 1952. Interim military specification: packing material, metallic and nonmetallic for MIL-P-17303 (SHIPS). p. 1-7.

U.S. Navy. 1953. Military Specification MIL-A-17472: Asbestos Sheet Compressed (Packing Material). MIL-A-17472. February 12, 1953. Washington, D.C.: Bureau of Ships, Navy Department.

U.S. Navy. 1955. BUMED Instruction 62.70.3., edited by the Bureau of Medicine and Surgery. p. 1-4. November 7, 1955.

U.S. Navy. 1959a. Bureau of Ships Technical Manual: Chapter 39, Thermal Insulation. NAVSHIPS 250-000. 15 April 1959. Washington, D.C.: U.S. Navy, Bureau of Ships.

U.S. Navy. 1959b. Military Specification: Insulation Felt, Thermal, Asbestos Fiber for MIL-I-0015091B (SHIPS).

U.S. Navy. 1960. Bureau of Ships Technical Manual, Vol. I: Thermal Insulation, Chapter 39. Washington, D.C.: U.S. Navy, Bureau of Ships. p. 1-155.

U.S. Navy. 1962. Military Specification: Insulation Felt, Thermal, Asbestos Fiber for MIL-I-15091C.

U.S. Navy. 1965. Bureau of Ships Technical Manual: Chapter 9390, Thermal Insulation. NAVSHIPS 250-000. November 1, 1965. Washington, D.C.: U.S. Navy, Bureau of Ships.

U.S. Navy. 1966. Bureau of Ships Technical Manual: Chapter 9390, Thermal Insulation. NAVSHIPS 250-000. January 15, 1966. Washington, D.C.: U.S. Navy, Bureau of Ships.

U.S. Navy. 1968. U.S. Navy Department Memorandum re: Hazards of Asbestos. December 9, 1968.

U.S. Navy. 1971. Memorandum from the Commander of the Naval Ships System Command re: NAVSHIPS INSTRUCTION 5100.26. NAVSHIPINST 5100.26. February 9, 1971.

U.S. Navy. 1972. Naval Ships' Technical Manual, Chapter 9390: Thermal Insulation. NAVSHIPS 0901-390-0002. NAVSHIPS 0901-390-0002. Washington, D.C.: U.S. Navy, Bureau of Ships.

U.S. Navy. 1975. Memo from Roger R. Beckett, Commanding Officer, Naval Regional Medical Center, Bremerton, WA to Commander, Puget Sound Naval Shipyard, Bremerton, WA (Superintendent Pipefitter). re: Airborne Asbestos Levels During Gasket Manufacture. December 12, 1975.

U.S. Navy. 1985. Federal Specification - Packing; Asbestos, Sheet, Compressed, HH-P-46E. July 26, 1985. Washington, D.C.: Bureau of Ships, Navy Department.

United States 91st Congress. 1970. Occupational Safety and Health Act of 1970. Public Law 91-596. Washington, D.C.: U.S. Government Printing Office.

Unknown. 1934. Asbestos umbrella protects firemen. Popular Science Monthly 125 (4):30-30.

USEPA (United States Environmental Protection Agency). 1974. Part 61---National emission standards for hazardous air pollutants: Asbestos, beryllium, and mercury. Fed Reg 39: 15396-15398. May 3, 1974.

USEPA (United States Environmental Protection Agency). 1978. Sprayed ACM in Buildings: A Guidance Document. Research Triangle Park, NC: U.S. Environmental Protection Agency, Office of Air and Waste Management, Office of Air Quality Planning and Standards.

USEPA (United States Environmental Protection Agency). 1985a. Guidance For Controlling Asbestos-Containing Materials in Buildings. EPA 560/5-85-024. June 1985. Washington, D.C.: Office of Pesticides and Toxic Substances, U.S. Environmental Protection Agency.

USEPA (United States Environmental Protection Agency). 1985b. Internal Memo from Steve Weil and Lynn Delpire to Amy Moll. RE: Asbestos Exposure - Brakes and Ambient. Washington, D.C.: U.S. Environmental Protection Agency (EPA), Office of Policy, Planning and Evaluation. October 17, 1985.

USEPA (United States Environmental Protection Agency). 1986a. Airborne asbestos health assessment update. EPA/600/8-84/003F. June 1986. Washington, D.C.: U.S. Environmental Protection Agency, Office of Health and Environmental Assessment.

USEPA (United States Environmental Protection Agency). 1986b. Guidance for Preventing Asbestos Disease Among Auto Mechanics. EPA-560-OPTS-86-002. June 1986. Washington, DC: U.S. Environmental Protection Agency, Asbestos Action Program.

USEPA (United States Environmental Protection Agency). 1986c. Guidelines for Carcinogen Risk Assessment. Published on September 24, 1986, Federal Register 51(185):33992-34003. EPA/630/R-00/004. September 1986. Washington, D.C.: Risk Assessment Forum, U.S. Environmental Protection Agency.

USEPA (United States Environmental Protection Agency). 1987. 40 CFR Part 763. [OPTS-62048E; FRL-3269-8]. Asbestos-Containing Materials in School. Final Rule. Fed. Reg. 52 (210): 41826-41898.

USEPA (United States Environmental Protection Agency). 1989. 40 CFR Part 763: Asbestos: Manufacture, importation, processing, and distribution in commerce prohibitions. Fed. Reg. 54: 29460-29513. July 1989.

USEPA (United States Environmental Protection Agency). 1990a. Managing asbestos in place: A building owner's guide to operations and maintenance programs for asbestos-containing materials. 20T-2003. Washington, D.C.: U.S. Environmental Protection Agency, Office of Pesticides and Toxic Substances. July 1990.

USEPA (United States Environmental Protection Agency). 1990b. Notice: Asbestos; Publication of Identifying Information. Fed Reg 55 (30): 5144-5162. February 13, 1990.

USEPA (United States Environmental Protection Agency). 1991. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual Supplemental Guidance "Standard Default Exposure Factors," Interim Final. OSWER Directive 9285.6-03. Washington, D.C.: U.S. Environmental Protection Agency, Toxics Integration Branch, Office of Emergency and Remedial Response. March 25, 1991.

USEPA (United States Environmental Protection Agency). 1992. Health Assessment Document for Talc. EPA-600/8-91/217. Washington, D.C.: Office of Reseach and Development, U.S. Environmental Protection Agency (EPA). March 1992.

USEPA (United States Environmental Protection Agency). 1993. Test Method: Method for the Determination of Asbestos in Bulk Building Materials. EPA/600/R-93/116. Research Triangle Park, NC: Atmospheric Research and Exposure Assessment Laboratory, U.S. Environmental Protection Agency (EPA). July 1993.

USEPA (United States Environmental Protection Agency). 1994. 40 CFR Part 763: Technical Amendment in Response to Court Decision on Asbestos; Manufacture, Importation, Processing and Distribution Prohibitions. Fed. Reg. 59: 33208-33211.

USEPA (United States Environmental Protection Agency). 1998. Asbestos containing materials. Dallas, TX: U.S. Environmental Protection Agency, Multimedia Planning and Permitting Division.

USEPA (United States Environmental Protection Agency). 2000. 40 CFR Part 61. National Emission Standard Hazardous Air Pollutants (NESHAP), Subchapter C--Air programs (continued). Accessed from July 17, 2014: http://legismex.mty.itesm.mx/secc_inter/40CFR/40CFRPART060.pdf.

USEPA (United States Environmental Protection Agency). 2001. Standard Operating Procedure (SOP) for Video Exposure Monitoring of Activities Potentially Associated with Exposure to Asbestos in Air. SOP EPA-Libby-2002. Revision #1. March 2001. Denver, CO: Region 8, U.S. Environmental Protection Agency.

USEPA (United States Environmental Protection Agency). 2003. EPA World Trade Center Background Study Report. Interim Final. Prepared for United States Federal Emergency Management Agency: IAG No. EMW-2002-IA-0127. April 2003. Accessed March 1, 2013: http://www.epa.gov/wtc/reports/background_study_report.pdf. New York: U.S. Environmental Protection Agency, Region 2, New York City Response and Recovery Operations.

USEPA (United States Environmental Protection Agency). 2005. Guidelines for Carcinogen Risk Assessment. EPA/630/P-03/001F. March 2005. Washington, D.C.: Risk Assessment Forum, U.S. Environmental Protection Agency.

USEPA (United States Environmental Protection Agency). 2008a. Framework for Investigating Asbestos-Contaminated Superfund Sites. OSWER Directive 9200.0-68. Washington, D.C.: U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Technical Review Workgroup, Asbestos Committee.

USEPA (United States Environmental Protection Agency). 2008b. Proposed Approach for Estimation of Bin-Specific Cancer Potency Factors for Inhalation Exposure to Asbestos. Washington, D.C.: U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. April 23, 2008.

USEPA (United States Environmental Protection Agency). 2009. Summary of Outdoor Ambient Air Monitoring for Asbestos at the Libby Asbestos Site Libby, Montana (October 2006 to June 2008). Denver, CO: U.S. Environmental Protection Agency, Region 8 and SRC. February 9, 2009.

USEPA (United States Environmental Protection Agency). 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-090/052F. September 2011. Washington, D.C.: National Center for Environmental Assessment, Office of Research and Development.

USEPA (United States Environmental Protection Agency). 2017. Risk Assessment for Carcinogenic Effects, January 31, 2017 [cited June 28, 2017]. Available from https://www.epa.gov/fera/risk-assessment-carcinogenic-effects.

USFDA (United States Food and Drug Administration). 1971. FDA Meeting Minutes- Asbestos in Cosmetic Talc. August 3, 1971 - Washington, D.C.

USFDA (United States Food and Drug Administration). 1973. 21 CFR Parts 121, 128, 133. Asbestos Particles in Food and Drugs. Notice of Proposed Rulemaking. Fed Reg 38 (188): 27076-27081. September 28, 1973.

USFDA (United States Food and Drug Administration). 1975. Asbestos-Form Particles in Drugs for Parental Injection. Fed Reg 40 (51): 11865-11870. March 14, 1975.

USFDA (United States Food and Drug Administration). 2014. Significant Dates in U.S. Food and Drug Law History. Accessed April 4, 2016: http://www.fda.gov/AboutFDA/WhatWeDo/History/Milestones/ucm128305.htm.

USFDA (United States Food and Drug Administration). 2016. 21 U.S.C. 393 - Food and Drug Administration. Accessed April 4, 2016: http://uscode.house.gov/view.xhtml?req=%28title:21%20section:393%20edition:prelim%29%20OR%20%28granuleid:USC-prelim-title21-section393%29&f=treesort&edition=prelim&num=0&jumpTo=true.

USP (United States Pharmacopeial Convention). 1981. Talc. In FCC111, Monographs, edited by USP. Rockville, MD: United States Pharmacopeial Convention. p. 318-319.

USP (United States Pharmacopeial Convention). 2011. Revision Bulletin: Talc. August 1, 2011. Accessed April 6, 2016: http://www.usp.org/sites/default/files/usp_pdf/EN/USPNF/revisions/m80360talc.pdf

Utah State Department of Health. 1945. Useful criteria in the identification of certain occupational health hazards: Division of Industrial Hygiene, Utah State Department of Health. p. 9, 30, 68.

Van Gosen, B. S., H. Lowers, A., S. Sutley, J., and C. Gent, A. 2004. Using the Geologic Setting of Talc Deposits as an Indicator of Amphibole Asbestos Content. Vol. 45. Berlin: Springer.

Verma, D. K., and C. G. Middleton. 1980. Occupational exposure to asbestos in the drywall taping process. Am Ind Hyg Assoc J 41 (4):264-9.

Verma, D. K., and C. G. Middleton. 1981. Exposure in the ceiling and wall texture process. Occup Health Saf 50 (3):21-24.

Vianna, N. J., and A. K. Polan. 1978. Non-occupational exposure to asbestos and malignant mesothelioma in females. Lancet 1 (8073):1061-3.

Viet, S. M., M. Stenzel, C. Rennix, T. Armstrong, and J. Couch. 2008. Guideline on Occupational Exposure Reconstruction. 1st Edition. Fairfax, VA: American Industrial Hygiene Association Press.

Virta, R. L. 2001. Some Facts About Asbestos. Reston, VA: U.S. Geological Survey.

Virta, R. L. 2002. Asbestos: Geology, mineralogy, mining, and uses. Open-File Report 02-149. Reston, VA: US Department of the Interior, US Geological Survey. October 2002.

Virta, R. L. 2005. Mineral commodity profiles: Asbestos. USGS Circular 1255-KK. Washington, D.C.: U.S. Department of the Interior, U.S. Geological Survey.

Virta, R. L. 2006. Worldwide Asbestos Supply and Consumption Trends from 1900 through 2003. Circular 1298. Washington, D.C.: U.S. Department of the Interior, U.S. Geological Survey.

Vorwald, A. J., T. M. Durkan, and P. C. Pratt. 1951. Experimental studies of asbestosis. AMA Arch Ind Hyg Occup Med 3 (1):1-43.

Vu, V. T. 1993. Regulatory approaches to reduce human health risks associated with exposures to mineral fibers. In Health Effects of Mineral Dusts. Volume 28: Reviews in Mineralogy, edited by G. D. Guthrie Jr. and B. T. Mossman. Washington, D.C.: Mineralogical Society of America. p. 545-554.

Wagner, J. C. 1965. Epidemiology of diffuse mesothelial tumors: Evidence of an association from studies in South Africa and the United Kingdom. Ann N Y Acad Sci 132 (1):575-8.

Wagner, J. C. 1990. Biological effects of short fibers. In Proceedings of the VIIth International Pneumoconiosis Conference Part II, November. DHHS (NIOSH) Publication No. 90-108 Part II. Animal Models- Pneumoconiosis I.

Wagner, J. C., C. A. Sleggs, and P. Marchand. 1960. Diffuse pleural mesothelioma and asbestos exposure in the North Western Cape Province. British Journal of Industrial Medicine 17:260-71.

Wagner, J. C., J. C. Gilson, G. Berry, and V. Timbrell. 1971. Epidemiology of asbestos cancers. Br Med Bull 27 (1):71-6.

Wedler, H. W. 1943a. Asbestose und Lungenkrebs [Asbestosis and Lung Cancer]. Deutsche Medizinische Wochenschrift 69:575-576.

Wedler, H. W. 1943b. Uber den lungenkrebs bei asbestose [Lung Cancer in Asbestosis Patients]. Dtsch. Arch. Klin. Med. 191:189-209.

Wegelius, C. 1947. Changes in the lungs in 126 cases of asbestosis observed in Finland. Acta radiol 28:139-152.

Weil, S., and L. Delpire. 1985. Internal Memo from Steve Weil (USEPA) and Lynn Delpire (USEPA) to Amy Moll (USEPA), RE: Examination of the Data on Worker Exposure to Asbestos Dust From Brake Relining and Maintenance Operations and Ambient Exposure to Asbestos. October 17, 1985.

Weill, H., J. Hughes, and C. Waggenspack. 1979. Influence of dose and fiber type on respiratory malignancy risk in asbestos cement manufacturing. Am Rev Respir Dis 120 (2):345-54.

Weir, F. W., G. Tolar, and L. B. Meraz. 2001. Characterization of vehicular brake service personnel exposure to airborne asbestos and particulate. Appl Occup Environ Hyg 16 (12):1139-46.

Weiss, W. 1977. Mortality of a cohort exposed to chrysotile asbestos. J Occup Med 19 (11):737-40.

Wendlick, J. D. 1983. Ambient Asbestos Fiber Levels in the Metropolitan Areas of Norfolk - Portsmouth - Newport News, Virginia. December 1983.

Wendlick, J. D. 1984. Ambient Asbestos Fiber Levels at Selected Sites in Philadelphia, Pennsylvania. November 1984. Federal Way, WA: Wendlick.

Wergeland, E., Aage Andersen, and Anders Berheim. 1990. Morbidity and mortality in talc-exposed workers. American Journal of Industrial Medicine 17 (4):505-513.

Williams, P. R., A. D. Phelka, and D. J. Paustenbach. 2007. A review of historical exposures to asbestos among skilled craftsmen (1940-2006). Journal of Toxicology and Environmental Health. Part B, Critical Reviews 10 (5):319-77.

Williams, P. R., J. Sahmel, J. Knutsen, J. Spencer, and A. L. Bunge. 2011. Dermal absorption of benzene in occupational settings: estimating flux and applications for risk assessment. Crit Rev Toxicol 41 (2):111-42.

Williams, R. C. 1923. Health Protection Against Dust and Fumes. National Safety News 7 (5):13-15.

Williams, R. L., and J. L. Muhlbaier. 1982. Asbestos brake emissions. Environ Res 29 (1):70-82.

Williams, W. J. 1957. Alveolar metaplasia: its relationship to pulmonary fibrosis in industry and the development of lung cancer. Br J Cancer 11 (1):30-42.

Wilson, C. H. 1977. Memo from Clifton H. Wilson (Division of Cosmetics Technology -Food and Drug Administration) to John P. Schelr (Chairman, CFTA Task Force on Round Robin), RE: Wilson's Results of Analysis of the Samples (Set J) for the CTFA Round Robin Analysis of Consumer Talc Products for Asbestiform Amphibole Minerals (With Attachment, Set J Results). Dated February 22, 1977

Winer, A., and W. Holtgren. 1976. Asbestos - A case study of the US Navy’s response to upgraded safety and health requirements. Naval Engineers Journal (December):41- 48.

Wood, W. B. 1929. Pulmonary asbestosis. Radiographic appearances in skiagrams of the chests of workers in asbestos. Tubercle 10 (8):353-363.

Wood, W. B., and D. S. Page. 1929. A case of pulmonary asbestosis. Tubercle 10:457-461.

Wood, W. B., and S. R. Gloyne. 1934. Pulmonary asbestosis: A review of one hundred cases. Lancet 227 (2):1383-1385.

Wylie, A. G. 1990. Report of Analysis for Southern Talc. January 30, 1990.

Wylie, A. G., and J. R. Verkouteren. 2000. Amphibole asbestos from Libby, Montana: Aspects of nomenclature. American Mineralogist 85 (10):1540-1542.

Wylie, A. G., R. L. Virta, and E. Russek. 1985. Characterizing and Discriminating Airborne Amphibole Cleavage Fragments and Amosite Fibers: Implications for the NIOSH Method. American Industrial Hygiene Association Journal 46 (4):197 - 201.

Yarborough, C. M. 2006. Chrysotile as a cause of mesothelioma: an assessment based on epidemiology. Crit Rev Toxicol 36 (2):165-87.

Yeung, P., K. Patience, L. Apthorpe, and D. Willcocks. 1999. An Australian study to evaluate worker exposure to chrysotile in the automotive service industry. Appl Occup Environ Hyg 14 (7):448-57.

Zenz, C. 1975. Occupational Medicine: Principles and Practical Applications. Chicago: Year Book.

Zimon, A. D., and M. Corn. 1969. Adhesion of Dust and Powder. New York: Plenum Press.

Zirschky, J. 1996. Take-home Toxin Pathway. J Environ Eng 122 (5):430-6.

Case Name	City/County, State	Topic	Deposition Date	Trial Testimony Date
Arthur Robert Stirrat, Plaintiff, vs. A.W. Chesterton Company et al. Defendants (regarding Sequoia Ventures, Inc.)	Los Angeles, California	Asbestos	8/22/2016	
Linda E. Colpitts and Michael Colpitts, vs. American International Industries, et al. (regarding Imerys Talc America)	Los Angeles, California	Talc (Asbestos)	8/23/2016	
Charles & Kathleen Holley vs. Ford Motor Company, et al.	Beaufort County, South Carolina	Solvents (Benzene)	8/25/2016	
Philip John Depoian and Julie Pastor Depoian vs. American International Industries Inc., et al. (regarding Colgate-Palmolive)	Los Angeles, California	Talc (Asbestos)	8/30/2016	
Richard Hurvitz and Carole Hurvitz vs. Pneumo Abex Corporation, et al. (regarding Lone Star Industries, Inc.)	Los Angeles, California	Asbestos	9/6/2016 & 11/15/2016	
Melvin Jones vs. Borgwarner Morse TEC LLC, et al. (regarding Shell)	Los Angeles, California	Asbestos	9/16/2016	
James Brown vs. Union Pacific Railroad Company	Madison County, Illinois	Creosote/Solvents		9/26/2016
Doris Jackson vs. Colgate-Palmolive Company (regarding Colgate-Palmolive)	District of Columbia	Talc (Asbestos)	10/4/2016	
Anna Blount vs. Colgate-Palmolive Company, et al. (regarding Colgate-Palmolive)	Los Angeles, California	Talc (Asbestos)	10/12/2016	11/18/2016
Karen S. Foster vs. Alcatel-Lucent USA Inc., et al; Debra and John Ehrenreiter vs. ABB, Inc., et al.; David and Se Young Sewell vs. ABB, Inc., et al. (regarding Colgate-Palmolive)	Madison County, Illinois	Talc (Asbestos)	10/17/2016	
Mary Lyons vs. Metropolitan Life Insurance (regarding Colgate-Palmolive and Cyprus Amax)	San Francisco County, California	Talc (Asbestos)	11/29/2016	
Judith Gullicksen vs. Basco Drywall & Painting Co., et al. (regarding Colgate-Palmolive)	Alameda County, California	Talc (Asbestos)	12/8/2016	
Judith Macias vs. C.H. Murphy/Clark-Ullman, Inc., et al. (regarding Ferro Engineering)	King County, Washington	State of Knowledge	12/15/2016	
Donald Johnson vs. Motiva Enterprises, LLC, Equilon Enterprises, LLC, Riverbend Shell Inc., and Diane Williams	Parish of New Orleans, Louisiana	Gasoline	1/26/2017	2/16/2017
Dennis John Zampa and Pamela S. Zampa vs. Georgia-Pacific LLC, et al.	Alameda County, California	Asbestos	2/27/2017	
Debra J. Greene vs. Union Carbide Corporation et al.; Donna L. Rutherford, Co-Personal Representative of the Estate of Elma Link et al. vs. Union Carbide et al. (regarding Colgate-Palmolive)	Baltimore City, MD	Talc (Asbestos)	4/6/2017	
David Lamar Taylor and Deborah Williford Taylor vs. 3M Company f/k/a Minnesota Mining and Manufacturing, et al. (regarding Fisher Controls International LLC)	Richland County, South Carolina	Asbestos	4/17/2017	
Beverly Dale Jolly and Brenda Rice Jolly vs. General Electric Company, et al. (regarding Fisher Controls International LLC)	Richland County, South Carolina	Asbestos	4/17/2017	
Louie Cervantes and Lupe Cervantes, Plaintiffs, vs. A.W. Chesterton Company, et al., Defendants (regarding CalPortland and Amcord)	Los Angeles, California	Asbestos	5/5/2017	
Janet Shaw, Individually and as Successor-in-Interest to Walter Shaw, deceased, Victoria Newsham, and Kerry Shaw vs. Amcord, Inc. et al.	Alameda County, California	Asbestos	5/11/2017	
Robert Harris Bailey vs. 3M Company f/k/a Minnesota Mining and Manufacturing Company, et al. (regarding Ferro Engineering)	Cuyahoga County, OH	State of Knowledge	5/22/2017	
Sharon M. Hanson and Douglas B. Hanson, Pltfs. vs. Colgate-Palmolive Company, et al. (regarding Colgate-Palmolive and Cyprus Amax)	Southern District of Georgia (Federal)	Talc (Asbestos)	6/22/2017	
Beverly Dale Jolly and Brenda Rice Jolly vs. General Electric Company, et al. (regarding Crosby Valve, Inc.)	Richland County, South Carolina	Asbestos	7/11/2017	8/1/2017-8/2/2017
Laina Jewel Bartlow and Kenneth David Bartlow v Brenntag North America et al.; Carol Schoeniger v Brenntag North America et al. (regarding Colgate-Palmolive, Imerys Talc America, and Cyprus Amax)	Middlesex County, New Jersey	Talc (Asbestos)	7/13/2017 & 7/27/2017	
Barbara and John Wittman vs. Brenntag North America, Inc. (regarding Colgate-Palmolive, Cyprus Amax, and Pfizer)	Los Angeles, California	Talc (Asbestos)	8/10/2017	
Marie Colette Gonzales, individually and as successor-in-interest to Jesse Gonzales, deceased, et al. vs. 3M Company, et al. (regarding Shell)	Los Angeles, California	Asbestos	8/21/2017	
Richard Booker and Cheryl Booker vs. BASF Catalysts LLC, et al. (regarding Pfizer)	County of Alameda, California	Talc (Asbestos)	8/29/2017	

Tina Herford vs. AT&T Corp., et al. (regarding Cyprus Amax)	Los Angeles, California	Talc (Asbestos)	9/5/2017	11/7/2017-11/8/2017
Susan E. Jenkins vs. Avon Products, Inc., et al. (regarding Cyprus Amax and Imerys Talc America)	San Diego, CA	Talc (Asbestos)	9/11/2017	
Salazar, Dorothy (WD: Joe C. Salazar) vs. Amcord, Inc., et al. (regarding CalPortland, Amcord, and Mission Stucco)	Los Angeles, California	Asbestos	9/15/2017	
Dale Chapp, Individually and as Personal Representative of The Estate of Ruth Chapp, Deceased, Pltf. vs. Borg-Warner Morse Tec LLC, etc., et al. (regarding Colgate-Palmolive and Cyprus Amax)	Milwaukee, Wisconsin	Talc (Asbestos)	10/2/2017	
Rae Ann Stevenson et al., vs. MCIC, et al. (regarding Colgate-Palmolive)	Washington County, MD	Talc (Asbestos)	10/11/2017	
Richard Abeyta, individually and as Personal Representative of the Estate of Frank Joe Abeyta, deceased, et al. vs. A&A Building Material Co., et al. (regarding Colgate-Palmolive and Imerys Talc America)	Los Angeles, California	Talc (Asbestos)	10/12/2017	
Christopher Lightfoot vs. Georgia-Pacific Wood Products, LLC, et al. (regarding Georgia-Pacific Wood Products)	Eastern District of North Carolina	Wood Dust	10/17/2017	
Wesley J. Quisenberry, Personal Representative of the Estate of Wanda J. Quisenberry, deceased vs. Borgwarner Morese Tec Inc., et al. (regarding Huntington Ingalls Incorporated)	Newport News, Virginia	State of Knowledge	10/19/2017	
Julia Goo v. Arcon, Inc., et al. (regarding Golden Gate Drywall)	Alameda County, California	Asbestos	10/23/2017	
Hinda Bartoli, individually and as successor in interest to Ronald Bartoli, deceased, Roseanna Bartoli, an individual; Dino Bartoli, an individual, vs. BorgWarner Morse TEC LLC, et al. (regarding BorgWarner Morse TEC)	Los Angeles, California	Asbestos	11/9/2017	
William S. Aby, Sr. and Cynthia R. Aby vs. Allied Packing & Supply Company, et al. (regarding BorgWarner Morse TEC)	Alameda County, California	Asbestos	11/15/2017	
Ann Patrice Gibbons and James Randall Gibbons vs. Axia Acquisition Corporation (regarding Pfizer)	Los Angeles, California	Talc (Asbestos)	11/28/2017	
James Logan and Kathleen Logan, v. Honeywell International Inc., fka Allied Signal, Inc., as successor-in-interest to the Bendix Corporation et al. (regarding BorgWarner Morse TEC LLC)	Alameda County, California	Asbestos	12/8/2017	
Angel D. Rigor vs. 3M Company a/k/a Minnesota Mining & Manufacturing Company, et al. (regarding BorgWarner Morse TEC LLC)	Alameda County, California	Asbestos	12/20/2017	
Harvey Kohr, Special Administrator of the Estate of Helene Kohr, Deceased, vs. Brenntag North America, Inc. et al. (regarding Colgate-Palmolive, Cyprus Amax, and Pfizer)	Cook County, IL	Talc (Asbestos)	1/10/2018	
James E. Parrott, vs. Adience, Inc., et al. (regarding Ferro Engineering)	Wayne County, MI	State of Knowledge	2/8/2018	3/13/2018
Richard Berg and Made Berg vs. Alta Building Material Co., et al. (regarding Colgate-Palmolive Co., as a successor in interest to The Mennen Company)	Alameda County, California	Talc (Asbestos)	3/5/2018	
Irene Delacruz and Julius Delacruz, Plaintiffs, vs. Brenntag North America, Inc., et al.; Carolyn Weirick and Elvira Graciela Escudero Lora vs. Brenntag North America, Inc., et al. (regarding Imerys Talc America and Cyprus Amax Minerals Company)	Los Angeles, California	Talc (Asbestos)	4/10/2018	9/11/2018-9/12/2018
Ilene Brick vs. Brenntag North America, Inc., et al. (regarding Imerys Talc America and Cyprus Amax Minerals Company)	Los Angeles, California	Talc (Asbestos)	4/24/2018	6/7/2018
Nancy Cabibi and Phil Cabibi vs. Avon Products, Inc., et al. (regarding Colgate-Palmolive Co. and Imerys Talc America)	Los Angeles, California	Talc (Asbestos)	4/26/2018	
Paula M. Garcia vs. Colgate-Palmolive Company, et. al. (regarding Colgate-Palmolive Co. and Imerys Talc America)	Los Angeles, California	Talc (Asbestos)	5/24/2018	
Michael Coons, individually and as Successor-in-Interest to Cynthia L. Coons, Deceased, Holly Coons, Individually, vs. 3M Company (f/k/a Minnesota Mining and Manufacturing), et al. (regarding BorgWarner Morse TEC Inc.)	Los Angeles, California	Asbestos	6/1/2018	
Jason Fleischer and Maria Graham, his wife, vs. ARC Roofing Corporation et al. (regarding ARC Roofing Corporation)	Mercer County, New Jersey	Roofing Adhesive	6/27/2018	
Kirk Von Salzen and Janet Von Salzen vs. American International Industries, Inc., et al. (regarding Imerys Talc America	Los Angeles, California	Talc (Asbestos)	7/12/2018	
Robert J. O'Donnell and Sandra O'Donnell v. W.F. Taylor Co., Inc. et al. (regarding Armstrong, Roberts, and WM Barr)	Palm Beach County, Florida	Solvents (Benzene)	7/17/208	

Dwaine T. Waters and Janice K. Waters, vs. Agco Corporation, et al. (regarding Colgate-Palmolive)	Richland County, South Carolina	Talc (Asbestos)	9/5/2018	
Melissa Hale, as Successor-in-Interest to and as Wrongful Death Heir of Kimberlee Hunter, deceased; and Jennylyn Henderson, et al. vs. Ford Motor Company, et al. (regarding Honeywell International Inc. (Bendix) and BorgWarner Morse TEC, Inc.)	Solano County, CA	Asbestos	9/7/2018	
Carla Allen vs. Brenntag North America, Inc., et al. (regarding Colgate-Palmolive)	Humboldt County, CA	Talc (Asbestos)	9/13/2018	10/30/2018
Patrick M. O'Reilly and Joan O'Reilly v. Air & Liquid Systems Corp. et al. (regarding Crane Co.)	Cook County, IL	Asbestos	9/20/2018	
Cynthia Hayes, as Executrix of the Estate of Donna Ann Hayes v. Colgate-Palmolive Company, et al. (regarding Colgate-Palmolive)	Jefferson County, KY	Talc (Asbestos)	10/9/2018	
Cleon Nolan Edwards, Individually and as Personal Representative of the Estate of Dianne S. Edwards, Deceased, and on behalf of all Wrongful Death Beneficiaries v. ABB, Inc., et al. (regarding Crosby Valve, LLC)	Pulaski County, AR	Asbestos	10/18/2018	
Jesse Henson as Power of Attorney for Dianne Henson vs. Allied Manufacturing Co., et al. (regarding Colgate-Palmolive)	Jackson County, MO	Talc (Asbestos)	11/30/2018	
Sharon Pipes and spouse Andrew Slupski vs. American Honda Motor Co., Inc., et al. (regarding Colgate-Palmolive Co., Imerys Talc America, and Cyprus Amax Minerals Co.)	Oklahoma County, OK	Talc (Asbestos)	12/11/2018	
SANDRA REYES JAUREGUI and MARIO REYES JAUREGUI vs. Ford Motor Company, et al. (Regarding BorgWarner Morse TEC Inc.)	Los Angeles, California	Asbestos	1/7/2019	
Marilyn A. Gardner, Individually and as Personal Representative of the Estate of Lester D. Gardner, Deceased, Plaintiffs, vs. ABB INC., et al. (Regarding Joy Global Surface Mining Inc. f/k/a P&H Mining Equipment Inc. f/k/a Harnischfeger Corp.)	Pierce County, Washington	Asbestos	2/6/2019	4/25/2019, 5/2/2019
George and Frances Hogue v. Allied Packing & Supply, Inc., et al. (regarding BorgWarner)	Alameda County, California	Asbestos	2/12/2019	
Dean Rininger, Individually and as Executor of the Estate of JoAnne Rininger, deceased vs. Hollingsworth & Vose Company, et al. (regarding Colgate-Palmolive Co.)	Summit County, Ohio	Talc (Asbestos)	2/13/2019	
Jody E. Ratcliff vs. American Honda Motor Co. Inc., et al. (regarding Imerys Talc America and Cyprus Amax Minerals Company)	King County, Washington	Talc (Asbestos)	2/26/2019	
Jamie Connor, Individually and as Executrix to the Estate of Matthew Janke and William Janke, Plaintiff(s) vs. 3M Company, et al. (regarding Honeywell International Inc. (Bendix) and BorgWarner Morse TEC, Inc.)	Middlesex County, New Jersey	Asbestos	3/12/2019	
Patricia Schmitz vs. Johnson & Johnson, et al. (regarding Colgate-Palmolive Co.)	Alameda County, California	Talc (Asbestos)	3/20/2019	5/14/2019-5/16/2019
KEVIN KORTE, as Personal Representative of the Wrongful Death Estate of RODOLFO GUTIERREZ, Deceased, and STELLA GUTIERREZ v. Burn Construction Company, Inc. (regarding Baker Hughes)	Santa Fe County, New Mexico	Asbestos	4/3/2019	7/25/2019
James Coleman Sizemore, as Personal Representative of the Estate of James Calvin Sizemore v. Bowater Paper Mill, et al. (regarding Crosby Valve)	Hampton County, South Carolina	Asbestos	4/30/2019	
Sebastian Bretado vs. 3M Company, et al. (regarding BorgWarner Morse TEC LLC)	Los Angeles, California	Asbestos	7/15/2019	
Jeanie McCrystal vs. Autozone Inc., et al. (regarding Honeywell International Inc. (Bendix))	Daviess County, Kentucky	Asbestos	7/16/2019	
Michael Charles Bell, et al. v. BorgWarner Morse Tec, Inc., et al. (regarding Honeywell International Inc. (Bendix); BorgWarner Morse TEC LLC as Successor-by-Merger to Borg-Warner Corporation; and Koons Chevrolet)	Baltimore City, MD	Asbestos	7/23/2019	
Diane Shoemaker French, as the Personal Representative of the Estate of Bobby Shoemaker, Deceases (regarding Premix-Marbletite Manufacturing Co.)	Broward County, FL	Asbestos	8/29/2019	
Melody Lewis and Robert Lewis v. A.W. Chesterton Company, et al. (regarding Colgate-Palmolive Co.)	Marion County, IN	Talc (Asbestos)	9/4/2019	
Henry S. Fisher, IV, and Claire Fisher vs. Actuant Corporation, et al. (regarding Kelsey-Hayes, individually and as a successor-in-interest to Fruehauf; and Mack Trucks, Inc.)	Baltimore City, MD	Asbestos	9/9/2019	

Larry Cole Sr., Individually, and as Personal Representative of the Estate of Larry Nathaniel Cole, Deceased, Elaine Cole, Drake Cole, by and through his Next Friend, Betsy Cole, and Lennox Cole, by and through his Next Friend, Cristina Patten vs. Honeywell International, Inc., et al. (regarding Honeywell International Inc. (Bendix))	Morgan County, MO	Asbestos	9/10/2019	
PIFER, RICHARD ERNEST (Deceased), et al., v. Barretts Minerals Inc., et al. (regarding Irwin Industrial Tool)	Baltimore City, MD	Chalk	10/7/2019	
Larry D. Wille, Individually and as a Representative of All Wrongful Death Beneficiearies, Treva Wille, et al. vs. Authorized Motor Parts Corporation, et al. (regarding O'Reilly Auto Parts)	Cass County, MO	Asbestos	10/24/2019	
Eric Klopman-Baerselman, as Personal Representative for the Estate of Rudie Klopman-Baerselman, deceased, vs. Air & Liquid Systems Corp. et al. (regarding BorgWarner Morse TEC LLC as Successor-by-Merger to Borg-Warner Corporation and regarding Honeywell International Inc., as a successor in interest to Bendix)	Tacoma, WA	Asbestos	10/29/2019	
Lubertha McLeod vs. AT&T, et al. (regarding Colgate-Palmolive Co.)	New Orleans, LA	Talc (Asbestos)	11/5/2019	
John Grimes vs. CBS Corporation, et al. (regarding Crane Co.)	New York County, New York	Asbestos	11/22/2019	
Robert N. Levesque, Individually and as Successor-in-Interest to Anne J. Levesque, deceased; Susan Dolby; Donald Levesque; Kevin Levesque, Shawn Levesque and Robert M. Levesque vs. Colgate-Palmolive Company, et al. (regarding Colgate-Palmolive Co.)	Alameda County, California	Talc (Asbestos)	12/16/2019	
Carol A. Lebrecht vs. American International Industries, et al. (regarding Colgate-Palmolive Co.)	Los Angeles, California	Talc (Asbestos)	12/17/2019	
Alfred Burton vs. 3M Company, et al. (regarding 3M)	King County, Washington	Employer Responsibility	1/30/2020	
Adam M. Breakell vs. 3M CO., et al. (regarding Honeywell International Inc. (Bendix) and Kelsey-Hayes)	Fairfield at Bridgeport, Connecticut	Asbestos	3/11/2020	
Antonio Mada & Isabel Mada vs. 3M Company, et al. (regarding Cincinnati Incorporated)	Los Angeles, California	Asbestos	4/28/2020	
Melvin Butler and Louise Threse Butler, his wife, vs. Cemex Construction Materials Florida, LLC., et al. (regarding Premix-Marbletite Manufacturing Co.)	Broward County, FL	Asbestos	5/5/2020	
Connie Lee Fink and Robert Ray Fink vs. Air & Liquid Systems Corporation, et al. (regarding BorgWarner Morse TEC LLC as Successor-by-Merger to Borg-Warner Corporation and regarding Honeywell International Inc., as a successor in interest to Bendix)	Milwaukee, Wisconsin	Asbestos	6/24/2020	
Kerry D. Vinson and Linda G. Vinson vs. Armstrong International, Inc., et al. (regarding Fisher Controls International and Crosby Valve)	Middle District of North Carolina	Asbestos	7/23/2020	